SORENSEN
POWER SUPPLIES

R.I.L.

# Instruction Manual

# STM Series

## HIGH EFFICIENCY SWITCHING POWER SUPPLIES

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588063 (1/79)
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SORENSEN
POWER SUPPLIES

# instruction manual for STM SERIES MODULAR DC POWER SUPPLIES

INCLUDES THE FOLLOWING STM MODELS:

| MODULE IVA | | MODULE VI | |
|---|---|---|---|
| 3.5-60 | 18-24 | 3.5-100 | 18-32 |
| 5-60 | 24-21 | 5-100 | 24-28 |
| 9-30 | 28-18 | 9-50 | 28-24 |
| 12-30 | 36-10 | 12-50 | 36-14 |
| 15-24 | 48-10 | 15-32 | 48-14 |

SORENSEN POWER SUPPLIES
SORENSEN COMPANY
A RAYTHEON COMPANY
676 ISLAND POND ROAD MANCHESTER, NEW HAMPSHIRE 03103

## FIVE-YEAR WARRANTY

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SORENSEN COMPANY

# TABLE OF CONTENTS


| Section | Title | Page |
|---|---|---|
| 1 | INTRODUCTION | |
| | 1.1 Purpose | 1-1 |
| | 1.2 General Description | 1-1 |
| | 1.3 Functional Description | 1-1 |
| | 1.4 Accessories | 1-1 |
| 2 | INSTALLATION | |
| | 2.1 General | 2-1 |
| | 2.2 Inspection | 2-1 |
| | 2.3 Input Connections | 2-1 |
| | 2.4 Electrical Check | 2-1 |
| | 2.5 Mounting | 2-1 |
| 3 | OPERATION | |
| | 3.1 General | 3-1 |
| | 3.2 Controls | 3-1 |
| | 3.3 Pre-Operation Considerations | 3-1 |
| | 3.4 Local Sensing | 3-2 |
| | 3.5 Remote Sensing | 3-2 |
| | 3.6 Remote Resistance Programming | 3-3 |
| | 3.7 Remote Voltage Programming | 3-3 |
| | 3.8 Series Operation | 3-3 |
| | 3.9 Parallel Operation | 3-3 |
| 4 | THEORY OF OPERATION | |
| | 4.1 Basic STM Principles | 4-1 |
| | 4.2 Circuit Description | 4-1 |
| 5 | SERVICE AND REPAIR | |
| | 5.1 General | 5-1 |
| | 5.2 Periodic Servicing | 5-1 |
| | 5.3 Test Equipment Required | 5-1 |
| | 5.4 Troubleshooting | 5-1 |
| | 5.5 Operational Checkout Procedures | 5-4 |
| 6 | REPLACEABLE PARTS LISTS | |
| | 6.1 Introduction | 6-1 |
| | 6.2 Table Headings Defined | 6-1 |


# LIST OF ILLUSTRATIONS


| Figure No. | Title | Page |
|---|---|---|
| 2-1 | Outline Drawing, STM Modules IVA and VI | 2-2 |
| 2-2 | Knockout Dimensions, STM Modules IVA and VI | 2-3 |
| 3-1 | Remote Sensing Connections | 3-2 |
| 4-1 | STM Simplified Block Diagram | 4-2 |
| 5-1 | Test Equipment Setup | 5-1 |
| 5-2 | Switching Transistor Waveforms | 5-8 |
| 5-3 | STM Units Typical Schematic Diagram | 5-9 |
| 5-4 | Module IVA-Typical Component Location | 5-10 |
| 5-5 | Module VI-Typical Component Location | 5-11 |
| 5-6A | Printed-Circuit Board A100 Assembly Drawing | 5-12 |
| 5-6B | Printed-Circuit Board A100 Schematic Diagram | 5-13 |
| 5-7A | A200 Printed-Circuit Board Assembly Drawing | 5-14 |
| 5-7B | A200 Printed-Circuit Board Schematic Diagram | 5-15 |
| 5-8 | Regulator Printed-Circuit Board Schematic and Assembly Drawings | 5-16 |


# LIST OF TABLES


| Table No. | Title | Page |
|---|---|---|
| 1-1A | Common Specifications | 1-2 |
| 1-1B | Unit Specifications Module IVA | 1-3 |
| 1-1C | Unit Specifications Module VI | 1-3 |
| 5-1 | Main Chassis Troubleshooting | 5-3 |
| 5-2 | Control Board A100 Trouble-shooting | 5-6 |
| 6-1 | Replaceable Parts List, STM Modules IVA/VI | 6-2 |
| 6-2 | Replaceable Parts List, STM Module VI | 6-5 |
| 6-3 | Replaceable Parts Output PCB Assy A200 | 6-9 |
| 6-4 | Replaceable Parts Output PCB Ass'y A200 | 6-11 |
| 6-5 | Replaceable Parts Control PCB Ass'y A100 | 6-13 |
| 6-6 | Replaceable Parts List, Preregulator PCB Ass'y | 6-17 |

# 1 INTRODUCTION

## 1.1 PURPOSE

This manual contains operation and maintenance instructions for the STM series of high efficiency modular dc power supplies, manufactured by the Sorensen Company, Manchester, New Hampshire. The STM models included in this manual are similar in electrical design and physical appearance. They are grouped into two module sizes; IVA and VI, differing only in size and in power output ratings. (Refer to Table 1-1, Unit Specifications.)

## 1.2 GENERAL DESCRIPTION

The STM series provides a variety of highly regulated dc outputs and is designed for operation on 115 Vac or 150 Vdc. The line also offers exceptionally high efficiency and fast recovery times as well as characteristically low output impedances.

The supplies are designed for mounting in any of three attitudes; end, bottom or side. Four tapped mounting holes are provided on front side, remove the case screws for side and bottom mounting. Section 2 provides necessary installation data.

## 1.3 FUNCTIONAL DESCRIPTION

Operational features of the STM series power supplies include remote sensing (regulating), remote programming, overload and short-circuit protection by automatic current-limiting, and over-voltage protection through an integral electronic crowbar shorting circuit.

### 1.3.1 Remote Sensing

For applications where variation in the load-lead voltage drop may adversely affect load regulation, remote sensing may be used to establish the regulating point at the load rather than at the output terminals.

### 1.3.2 Remote Programming

The STM series power supply outputs may be altered from a remote location by either the resistance or the voltage programming methods. For resistance programming, a calculated value of resistance at the ratio of 1000 ohms/volt is inserted in the programming network. For voltage programming a value of voltage at the ratio of 1:1 is inserted.

### 1.3.3 Series Operation

For applications requiring output voltages higher than a single unit can provide, STM units may be connected in series to a maximum total of 200 Vdc. Regulation in series operation is the sum of the regulations of all units.

### 1.3.4 Parallel Operation

Consult factory for requirements.

### 1.3.5 Over-Current Protection

In the event of an excessive current condition, such as a short-circuit, a current-limit circuit acts to reduce the unit output voltage. This circuit is factory-set to at least 110% of the unit rated output current at 40°C (+104°F).

### 1.3.6 Over-Voltage Protection (OVP)

In the event of an over-voltage condition on the output, such as a failure in the power supply or an externally induced condition, an over-voltage electronic crowbar is actuated by an integral OVP sensing circuit. The crowbar acts to quickly reduce the output voltage to zero and to disable the input dc circuit.

## 1.4 ACCESSORIES

Several universal rack-mount adaptors are available for the STM series. For specific information on these adaptors, contact your service representative, or the factory.

Table 1-1A Common Specifications

| | |
|---|---|
| Input Ratings: | AC: 105-132 volts, 50-440 Hz, single phase<br>DC: 127-173 Vdc |
| Maximum Input Current: | |

| Nominal Input Voltage | Module IVA Amperes | Module VI Amperes |
|---|---|---|
| 115 Vac | 9.1 | 12.8 |
| 150 Vdc | 4.8 | 6.7 |

| | | |
|---|---|---|
| Recommended Fuse, @ Nominal Input Voltage: | 10 | 15 |

| | |
|---|---|
| Output Ratings: | |
| Efficiency | To 75% |
| Voltage Regulation | 0.05% (combined line and load) |
| Ripple, RMS | 5 mV maximum (10 mV on 3.5/5-volt models)* |
| Ripple, P-P | 50 mV maximum (typically 30 mV) |
| Temp. Coefficient | 0.01% per $^{o}$C |
| Turn-ON/OFF Overshoot | None (output voltage) |
| Transient Response | 1.0 millisecond for half-load change/return to 1% band |
| Remote Programming | 1000 ohms-per-volt (resistance)/1V:1V (signal) |
| Output Impedance: | Typically less than<br>0.005 ohm @ 10 kHz<br>0.01 ohm @ 50 kHz<br>0.015 ohm @ 100 kHz<br>0.02 ohm @ 500 kHz |

**RMS Ripple Note*
*Valid at 50/60Hz. For higher input frequencies, ripple may be greater.*

| | |
|---|---|
| Current Limit: | Automatic, internally adjustable from zero to 125% of rated full-load current. Factory set to approximately 110% of rated (40$^{o}$C) current. (See individual unit specification.) |
| Over-Voltage (OVP) Limit: | Automatic, adjustable crowbar action, self-contained. Factory-set at 1V or 10% of nominal output voltage. (See unit specifications.)<br>Reset requires cycling input power. (Allow 30 seconds for discharge of input capacitors.)<br>OVP action is delayed (typically) by approximately 100 microseconds to avoid nuisance tripping.<br>Resolution of OVP adjust 0.1% of output voltage rating (typical).<br>OVP stability 2% of voltage trip setting for all conditions (typical). |
| EMI (RFI): | Designed to meet most portions of MIL-STD-461A. |
| Stability: | After one hour warm-up, 0.05% for 25 hours with all external effects held constant. |
| Resolution: | 0.05% of output voltage maximum. (See individual unit specifications.) |
| Parallel Operation: | Consult Factory. |
| Series Operation: | To 200 Vdc maximum. |
| Remote Sensing: | The voltage drop per load lead is constrained only by the maximum rated unit output voltage. (For example, 5-volt nominal STM supplies have an $E_O$ maximum of 6 volts. Thus, operating at an output of 5 volts allows a total of 1 volt total lead drop, or 0.5 volt-per-load lead.) |
| Ambient Rating: | 0 to 71$^{o}$C/32 to 160$^{o}$F. (See current ratings in unit specifications.) |
| Cooling: | Natural convection. |

| Dimensions in inches (mm) | Module IVA | Module VI |
|---|---|---|
| Width | 7-1/2 (190) | 7-1/2 (190) |
| Height | 4-15/16 (125) | 4-15/16 (125) |
| Depth | 10-1/2 (266) | 14 (356) |

| | Module IVA | Module VI |
|---|---|---|
| Weight in lbs (kg) | 17-3/4 (8) | 21 (9.5) |
| Volume in cu.in. (cu.m) | 394 (6.5) | 525 (8.6) |

| | |
|---|---|
| Input/Output Connections: | All connections are made to a 7-terminal barrier strip using #5-40 screws. |

Table 1-1B Unit Specifications Module IVA

| Model No. | 3.5-60 | 5-60 | 9-30 | 12-30 | 15-24 | 18-24 | 24-21 | 28-18 | 36-10 | 48-10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Output Ratings (dc): | | | | | | | | | | |
| Nominal Voltage (V) | 3.5 | 5.0 | 9.0 | 12.0 | 15.0 | 18.0 | 24.0 | 28.0 | 36.0 | 48.0 |
| Voltage Range (V) | 3.0-4.5 | 4.5-6.0 | 6-10 | 9.5-13.5 | 13-17 | 16-20 | 19-25 | 24-30 | 29-43 | 42-56 |
| Regulation (mV) | 1.75 | 2.5 | 4.5 | 5.0 | 7.5 | 9.0 | 12.0 | 14.0 | 18.0 | 24.0 |
| Current (A); | | | | | | | | | | |
| @ 40°C | 60 | 60 | 30 | 30 | 24 | 24 | 21 | 18 | 10 | 10 |
| @ 50°C | 48.6 | 48.6 | 24.3 | 24.3 | 19.4 | 19.4 | 17 | 14.5 | 8.1 | 8.1 |
| @ 60°C | 37.2 | 37.2 | 18.6 | 18.6 | 14.4 | 14.4 | 13 | 11.1 | 6.2 | 6.2 |
| @ 71°C | 24 | 24 | 12 | 12 | 9.6 | 9.6 | 8.4 | 7.2 | 4 | 4 |
| Current Limit (Adc) Factory set to; | 66 | 66 | 33 | 33 | 26.4 | 26.4 | 23.1 | 19.8 | 11 | 11 |
| Over-Voltage Limit (Vdc) Factory set to; | 4.5 | 6.0 | 10.0 | 13.2 | 16.5 | 19.8 | 26.4 | 30.8 | 39.6 | 52.8 |
| Input Ratings (Typ.) Efficiency (%) | 60 | 65 | 69 | 72 | 72 | 74 | 74 | 76 | 76 | 78 |
| Output Adjust Resolution (mV) | 2.25 | 3.0 | 5.0 | 6.75 | 8.5 | 10.0 | 12.5 | 15.0 | 21.5 | 28.0 |

Table 1-1C Unit Specifications Module VI

| Model No. | 3.5-100 | 5-100 | 9-50 | 12-50 | 15-32 | 18-32 | 24-28 | 28-24 | 36-14 | 48-14 |
|---|---|---|---|---|---|---|---|---|---|---|
| Output Ratings (dc): | | | | | | | | | | |
| Nominal Voltage (V) | 3.5 | 5.0 | 9.0 | 12.0 | 15.0 | 18.0 | 24.0 | 28.0 | 36.0 | 48.0 |
| Voltage Range (V) | 3.0-4.5 | 4.5-6.0 | 6-10 | 9.5-13.5 | 13-17 | 16-20 | 19-25 | 24-30 | 29-43 | 42-56 |
| Regulation (mV) | 1.75 | 2.5 | 4.5 | 6.0 | 7.5 | 9.0 | 12.0 | 14.0 | 18.0 | 24.0 |
| Current (A); | | | | | | | | | | |
| @ 40°C | 100 | 100 | 50 | 50 | 32 | 32 | 28 | 24 | 14 | 14 |
| @ 50°C | 81 | 81 | 40.5 | 40.5 | 25.9 | 25.9 | 22.6 | 19.4 | 1.3 | 1.3 |
| @ 60°C | 62 | 62 | 31 | 31 | 19.8 | 19.8 | 17.3 | 14.8 | 8.6 | 8.6 |
| @ 71°C | 40 | 40 | 20 | 20 | 12.8 | 12.8 | 9.2 | 8.8 | 5.6 | 5.6 |
| Current Limit (Adc) Factory set to; | 110 | 110 | 55 | 55 | 35.2 | 35.2 | 30.8 | 26.4 | 15.4 | 15.4 |
| Over-Voltage Limit (Vdc) Factory set to; | 4.5 | 6.0 | 10.0 | 13.2 | 16.5 | 19.8 | 26.4 | 30.8 | 39.6 | 52.8 |
| Input Ratings (Typ.) Efficiency (%) | 60 | 65 | 69 | 72 | 72 | 74 | 74 | 76 | 76 | 78 |
| Output Adjust Resolution (mV) | 2.25 | 3.0 | 5.0 | 6.25 | 8.5 | 10.0 | 12.5 | 15.0 | 21.5 | 28.0 |

# 2 INSTALLATION

## 2.1 GENERAL

After unpacking, general inspection and preliminary check-out procedures should be performed to assure that the unit is in proper working order. If it is determined that the unit has been damaged, the carrier should be notified immediately. Repair problems may be directed to the nearest Sorensen representative, or to the Service Department, Sorensen Company, Manchester, New Hampshire.

## 2.2 INSPECTION

Check for damage incurred during shipment as follows:

1. Inspect enclosures for dents, chips and other obvious signs of damage.
2. Check condition of external terminal board. Make certain that all terminal screws are in place and that links are fitted over the barrier strips between terminals 1 and 2, and between 3 and 4.
3. Inspect fuse holders for evidence of damage.
4. If internal damage is suspected,
   a. Remove all flat-head retaining screws from around the perimeters of the case assembly.

*NOTE*

*It is only necessary to remove the top (and one side) of the casing.*

   b. Inspect the components and printed circuit board (PCB) for damage.
5. Check that the power transistors are firmly plugged into their sockets. These are readily removable for servicing.

## 2.3 INPUT CONNECTIONS

STM units are shipped ready for use with either 115 Vac or 150 Vdc.

*NOTE*

*For either connection, fuse F1 is in series with the input line connected to TB1, Pin 7. Maximum circuit protection is provided when the high side of the input line (the black wire in standard ac connections) is connected to this pin.*

## 2.4 ELECTRICAL CHECK

**CAUTION**

*Before applying power to the unit, it is important that input/output isolation be checked. This may be done using a VOM set to the x 10 K scale. Assure maximum resistance from input at TB1-6 and -7 to case (ground), and output at TB2-1 to case. It is recommended that this measurement be performed each time the unit case is removed and replaced.*

To perform an initial electrical check, proceed as follows:

1. Make certain that unit is located in an area where free passage of air is unrestricted. Connect input leads to terminals TB1-6 and -7 (IN). Use terminal 5 (GRD) for input system ground.
2. Connect a dc voltmeter across terminals TB1-1 and -4 (OUTPUT SENSING). Select a voltage range compatible with rated output.
3. Apply nominal rated input power.
4. Rotate output adjust sufficiently to swing the dc voltmeter from minimum rated voltage to nominal output voltage per Table 1-1. (Adjustment to 1 volt or 10% higher than nominal output will trip the OVP.)
5. Set output voltage at its nominal value and remove input power.

## 2.5 MOUNTING

STM units may be mounted in a variety of positions and locations, including rack mounting.

*NOTE*

*Specific data for rack mounts is available at the factory. Figure 2-1 is an overall outline drawing of the STM modules.*

**CAUTION**

*Mount the units only where the horizontal surfaces and heat sink will be open to free vertical airflow. Use mounting surface knockouts as required per Figure 2-2.*

1. For cantilever-type mounting from a vertical panel or wall (where free access to vertical airflow is available):

   End mounting - Use knockout per Figure 2-2. This knockout clears the terminal block and fuses.

   Side or bottom mounting - Use knockout and four mounting holes shown in Figure 2-2.

2. For flat mounting from a horizontal surface (where free access to vertical airflow is available):

   End mounting - Not recommended.

   Side mounting - See knockout per Figure 2-2.

   Bottom mounting - Use knockout per Figure 2-2.

3. Vertical panel mounting per paragraph 1 preceding is preferred since maximum airflow is assured. Horizontal surface mounting per paragraph 2 preceding, using bottom mounting with proper knockout is the second preference.

4. Mounting screws should be No. 10-32 and just long enough to penetrate 1/4 inch into the STM unit and through the mounting surface with lock/flat washers used. (For side and bottom mounting remove existing screws.)

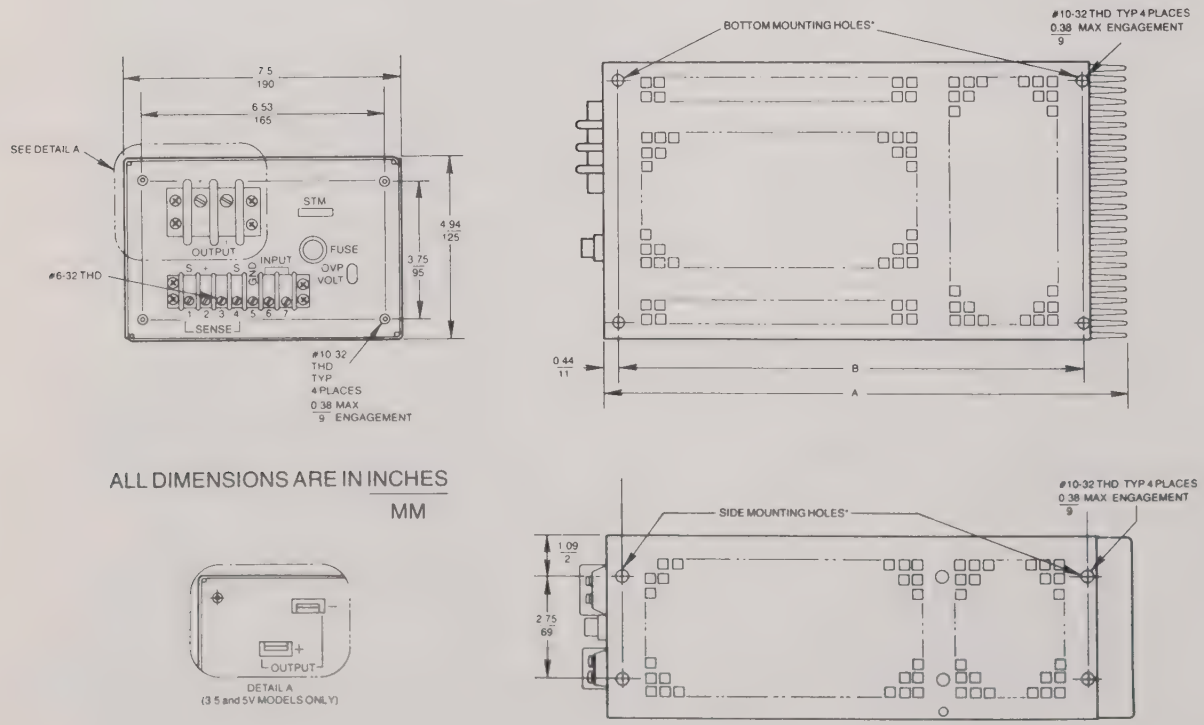


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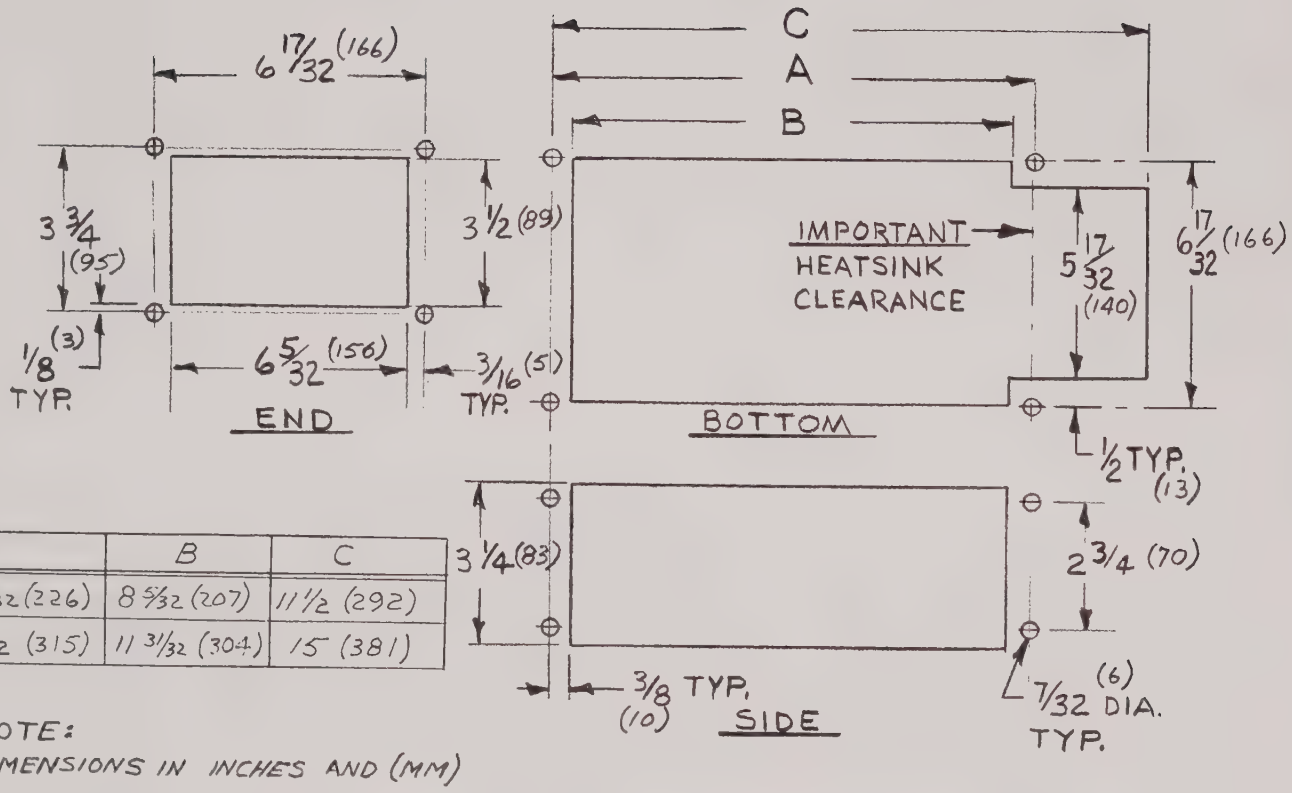
Figure 2-1 Outline Drawing, STM Modules IVA and VI




| MODULE | A | B | C |
|---|---|---|---|
| IVA | 8 29/32 (226) | 8 5/32 (207) | 11 1/2 (292) |
| VI | 12 13/32 (315) | 11 31/32 (304) | 15 (381) |

NOTE:
DIMENSIONS IN INCHES AND (MM)

Figure 2-2 Knockout Dimensions, STM Modules IVA and VI

# 3 OPERATION

## 3.1 GENERAL

This section contains instructions on how to adapt the unit to, and operate it in, a number of varied applications. These include remote sensing, remote programming, and series operation.

**CAUTION**

1. *The sensing and power circuits form a closed loop. Opening this loop, either by removing a terminal board link or disconnecting a sensing or programming lead will result in a high unit output and will cause the OVP crowbar to operate.*

2. *Operation will be stopped when line voltage falls below 85-95 Vac (depending on output load) for more than 50 milliseconds.*

## 3.2 CONTROLS

STM units are equipped with two controls; the output adjust and the OVP adjust potentiometers. The output adjust control is used to vary the output voltage while the OVP adjust control is used to vary the OVP trip point. Both are factory-set to nominal values (see Table 1-1).

## 3.3 PRE-OPERATION CONSIDERATIONS

### 3.3.1 Current Limit Setting

The current limiting point is factory-set to approximately 110% of rated 40°C current. If the unit is to be operated in other ambients, the rated output current is derated per Table 1-1. To assure full warranty protection, THE CURRENT-LIMIT MUST BE RESET TO 110% OF THE DERATED CURRENT VALUE.

### 3.3.2 Current Limit Reset

To reset the current limit proceed as follows:

1. Set unit to ON at no load. Adjust the output to nominal (rated) voltage.

2. Remove input power and connect an ammeter and variable load resistor in series across the output terminals.

3. Reapply input power and adjust load so that the test ammeter indicates current limit determined in paragraph 3.3.1.

4. Adjust output current (R28 at top of A100 PCB) to 10% of maximum load current (e.g. 10 Amperes for a unit rated at 100 Amperes), above the desired output current.

5. Rotate A100 R28 slowly counterclockwise (CCW) until both output voltage and current begin to drop.

6. Remove input power, disconnect test instruments and load.

### 3.3.3 Over-Voltage Trip Point

The OVP trip point is factory set to 1V or 10% (whichever is greater) higher than the rated nominal output voltage (Table 1-1). However, if the output voltage will be operated near its maximum rating, it may be desired to raise the trip point. For nuisance-free OVP, the trip point should be maintained at least 1V or 10% (whichever is greater) above the operating voltage. For example, a 5V model operating at 5.5V should use a 6.5V trip setting.

### 3.3.4 OVP Trip Point Reset

To reset the OVP, proceed as follows:

1. Rotate OVP control on panel fully CW.

2. Rotate output control on panel until the output voltage is equal to the desired trip point.

3. Rotate OVP control slowly CCW until the output voltage suddenly drops to zero. This indicates OVP has triggered the crowbar.

4. Remove the input power. Rotate output control CCW. Allow approximately 30 seconds for unit to discharge.

5. Apply input power. Reset output until desired operating voltage is obtained.

*NOTE*

*The OVP circuit includes a time-delay network such that the over-voltage (OV) condition must exist for approximately 100 microseconds before*

*the OVP fires. This delay prevents short-duration OV pulses from triggering the crowbar.*

### 3.3.5 Reset After OVP Fires

If the OVP fires, proceed to reset the circuit as follows:

1. Remove input power and disconnect load (in case OV condition is externally induced). Allow approximately 30 seconds for unit to discharge.
2. Rotate output adjust fully CCW (minimum voltage).
3. Apply input power and raise output voltage to desired value.

*NOTE*

*If the OVP again trips, internal failure is indicated, or the output is set too close to operating voltage (see 3.3.4 above).*

## 3.4 LOCAL SENSING

The unit is shipped ready for use in the local-sensing mode. In this mode, regulation is at the output terminals, not at the load. If variations in load-line voltage drops are expected to be prohibitive, refer to paragraph 3.5, remote sensing.

To operate the unit, proceed as follows:

1. Connect a voltmeter across output sense terminals TB1-1 (+) and TB1-4 (-).
2. Attach the input leads to terminals TB1-6 and -7. Use terminal 5 (GRD) to ground input system.
3. Apply nominal input power.
4. Rotate output adjust until desired output voltage is indicated on voltmeter.
5. Remove input power, disconnect voltmeter and connect load leads to terminals TB2-1 and -2. Do not remove or loosen any of the interconnecting links. Apply nominal input. Unit supplies highly regulated power to load.

**CAUTION**

*Do not touch enclosure while unit is operating under load. Surface temperature is comparatively high. If unit must be handled immediately after operation, wear heat-resistant gloves.*

## 3.5 REMOTE SENSING

If it is desirable to sense (regulate) unit output at the load rather than at output terminals, remove the links between terminals TB1-1 and -2, and TB1-3 and -4. Run a sensing lead from terminal TB1-1 to the positive side of load; connect the other lead from terminals TB1-4 to the negative side of load (see Figure 3-1). Sensing leads should be fabricated using a shielded, twisted pair of wires. Set unit in operation per paragraph 3.4.

*NOTE*

*A 1.0uF capacitor connected across TB1-3/-4 will prevent possible unit damage from voltage surge if sense leads are suddenly opened. Connect at terminal strip.*

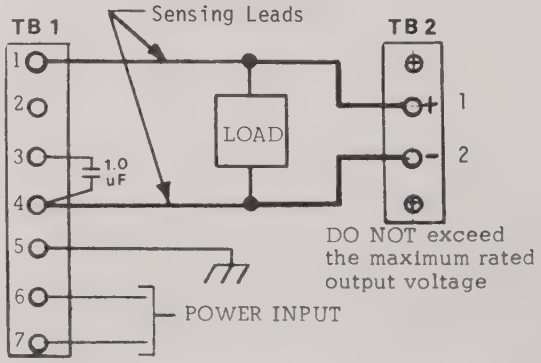



Figure 3-1 Remote Sensing Connections

## 3.6 REMOTE RESISTANCE PROGRAMMING

The unit may be programmed to supply pre-determined output voltages by inserting a calculated resistance into the voltage-sensing circuit. Programming sensitivity is approximately 1000 ohms-per-volt; that is 1000 ohms are required for each volt difference between the desired output and the minimum value of the unit's specified range. The program resistor should be a 1/8-watt (or larger) precision film resistor with a 25 PPM/°C coefficient (equal to MIL style RN55E). The programming current is approximately 1 milliampere. However, a 1 uF capacitor in parallel with the inserted programming resistor is required to prevent the unit from oscillation. Connect the capacitor at the unit terminal strip. To adapt the unit for remote programming, proceed as follows:

1. With normal local sensing (paragraph 3.4), set power to ON and adjust output to specified rated minimum output voltage (see Table 1-1 for specific model). For example, for a 12V module set the output to 9.5 volts.

2. At this point, any value within rated output range (Table 1-1) can be obtained by inserting 1000 ohms-per-volt difference between the desired voltage and the minimum voltage. For example, to obtain 12.0-volt output in the above example, the difference is 12.0 (-) or 2.5 volts. The program resistor should be 2.5 x 1000 or 2.5 K ohms.

3. Parallel the program resistor with a 1.0 uF capacitor.

4. Set power to OFF. Remove the link from TB1-3 and -4 and connect programming resistor in its place. Note that either local or remote sense can be used.

5. Apply input power and verify load voltage across terminals TB2-1 and -2 as the desired value (using local sense).

## 3.7 REMOTE VOLTAGE PROGRAMMING

For remote voltage programming, a floating voltage source is used in place of a programming resistor. The programming sensitivity is then one programming volt-per-volt. As in resistive programming, it is only allowable to program above the units rated minimum output voltage (Table 1-1) so as to maintain the operating stability.

## 3.8 SERIES OPERATION

Series operation is utilized for the purpose of obtaining a higher output voltage than available from a single mode. Two supplies may be connected in series (to a maximum of 200Vdc) to form a dual polarity (+) & (-) output system such as (±)12V with a common return. Any amount of bridging load may be tolerated.

## 3.9 PARALLEL OPERATION

Consult factory for parallel operation considerations.

# 4 THEORY OF OPERATION

## 4.1 BASIC STM PRINCIPLES (Refer to Figure 4-1; Block Diagram)

STM circuitry incorporates 20-kHz switching techniques, contributing to high efficiency and exceptional power density (high power output capability vs. small physical size).

The basic circuit consists of a 20-kHz push-pull, pulse-width modulated inverter operating directly from the rectified ac line. The inverter output is rectified and filtered in a double LC filter, and the resultant dc output voltage is sensed and compared with a reference voltage. Any difference, or error voltage, is amplified and fed back to the inverter to control the pulse width. Thus a closed loop is achieved, resulting in excellent line/load regulation.

## 4.2 CIRCUIT DESCRIPTION

### 4.2.1 Input Circuits (Refer to Schematic Diagram, Figure 5-3)

Input power is full wave rectified through diode bridge CR1 and filtered by C2 and C3 for module IVA, plus a C4 for Module VI. Approximately 150Vdc (depending on the input line variations) appear across all capacitors on which are superimposed a 120 Hz component (twice the line frequency). This DC control voltage establishes the operating levels of two separate networks. One is the push-pull inverter T1, Q1 through Q4, and the other is the preregulator board 982111 encompassing Q1 through Q4 and VR1, which provides a regulated voltage source for critical inverter drive and control circuits on the A100 board.

#### 4.2.1.1 Preregulator Board (Refer to Figure 5-8)

The preregulator board has two functions; voltage regulation and current limiting/protection. For clarity, these functions will be described separately.

##### 4.2.1.1.A Voltage Regulation

The 150Vdc (unregulated) DC input is applied to the preregulator at the collector of pass transistor Q1. AC line voltage is rectified and filtered by CR1, CR2, and C1. The resultant DC voltage is applied to Q2 as a bias and also serves as a source of power for control transistor Q3. In calubiation this is adjusted slightly above the emitter reference voltage set by VR1 so the drive to the base of Q1, through Q2, will track changes in the input voltage in the proper phase relationship to increase output with a decreasing input and vice versa.

As an example, assue an increase in line voltage which will also increase the DC input to Q1. The DC output at Vo will rise correspondingly. This rise will also increase the level at the base of Q3 derived from the pick-off point of R9.

The emitter of Q3 is held constant by VR1 causing Q3 to turn-on harder. This will increase the current drawn through R2, effectively decreasing the voltage level at the base of Q2 and, through cascading, the base of Q1. The emitter of Q1 will follow the reduction of voltage until the circuit reaches a state of equlibrium holding Vo at 110 Vdc.

##### 4.2.1.B Current Limiting/Short Circuit Protection

Q4 serves as a current limiter which will maintain a preset current level under heavy load conditions or drop the current to a very low value in the event of a short circuited output. For current limiting assume and increased load at Vo greater than the preset limiting point. The voltage dropped across R6A and B will increase which will increase the voltage on the base of Q4 greater than the emitter, causing Q4 to turn on harder. This will cause greater current flow through R2 duplicating the control action of Q2 and Q1 outlined above. The voltage will drop to a level which will hold the current output to its preset level.

In the event of a short circuit at Vo, however, the current limiting would not be effective in protecting the circuit, as excessive voltage would be dropped across Q1. Voltage divider R3 and R4 are set so the bias at the base of Q4 is near the current limiting point but does not exceed it. When a short circuit takes place at Vo, the voltage at Q4 base will rise quickly, turning Q2 and Q1 off. This will allow only a small fraction of the normal preset current level. This reduced current at the short circuit prevents overheating, and eventual destruction, of Q1.

### 4.2.2 Ramp Generator Circuit (Figure 5-6)

The ramp generator, consisting of (A100) Q5, C3, and R9, is designed to operate at a repetition rate of 40 kHz, and serves as the master "clock" for the power supply.

Capacitor A100C3 charges at a pre-determind rate until its voltage reaches a level established by A100VR3. At that point, programmable unijunction transistor (PUT) A100Q5 fires, resetting the ramp generator. The ramp output is fed to comparator circuit A100U3, and a trigger pulse developed across A100R10 is fed to the multivibrator circuit at A100U2.

### 4.2.3 Snap-On Circuit

This circuit consists of components (A100) U1, Q1, Q2, Q3, CR2 and CR3. The function basically is to operate as an under voltage protection. The comparator U1 will sense the dc voltage across the input circuit and hold down the driving current (through CR2 and CR3) to the bias inverter until the input voltage reaches

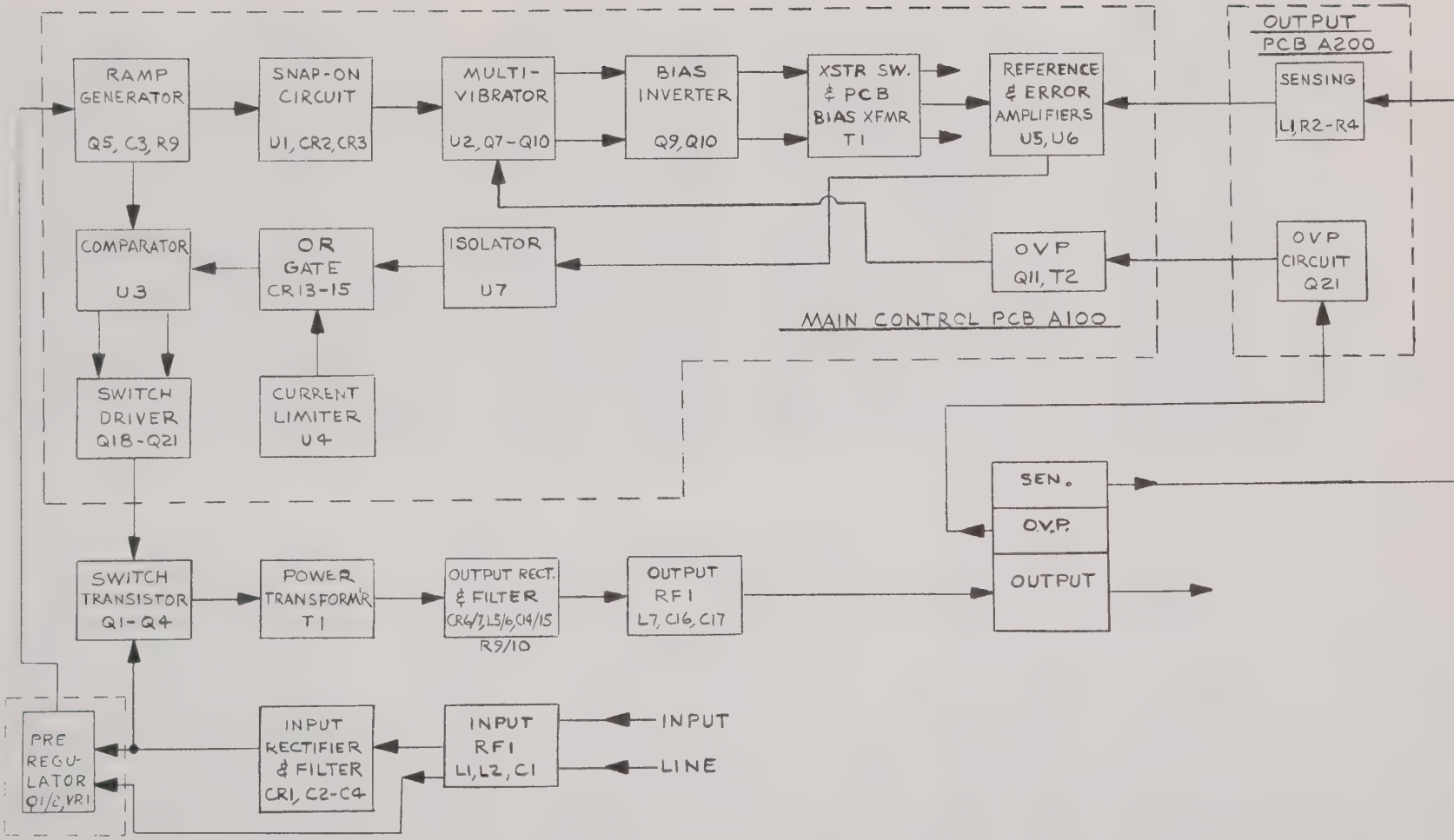



Figure 4-1 STM Simplified Block Diagram

approximately 110 Vdc (or 85-95 Vac depending on the output load), necessary for the proper functioning of the power supply.

4.2.4 Multivibrator and Bias Supply

The multivibrator (MV) circuit provides a square-wave output at 20 kHz (just half of the ramp generator trigger pulse repetition rate) which supplies the base drive for bias inverter transistors (A100) Q9 and Q10. These in turn drive the primary of bias supply transformer A100T1. The 150 Vdc rectified input is reduced to 16.7 volts by the action of (A100) VR1 and VR2, with A100Q4 being used for the purpose of initial startup. When this bias reaches 16.7 volts, the trigger pulse at A100Q6 drives the multivibrator flip-flop (A100U2), which in turn drives inverter transistor (A100) Q9 and Q10. The bias transformer A100T1 is then operating with a 20-kHz square wave on all windings.

The four separate secondaries of A100T1 function as follows:

1. Pins 2, 3 & 8 develop bias voltages for the comparator, and the current limiter A100Q5 and associated circuitry.

2. E1, E5 & E6 supply base drive current for main switching transistors Q1, Q2, Q3 & Q4 through A100Q18, Q19, Q20 & Q21 respectively.

3. Pins 4, 5 & 6 provide bias for reference and error amplifier cirucitry A100U5 & U6 and associated components.

4. E2, E3 & E4 provide the bias voltage for the OVP circuit.

4.2.5 Comparator and OR Gate

The comparator circuit consists primarily of the integrated circuit comparator (A100) U3. It's function is to compare the output of the ramp generator (at Pin 4) with the variable output of the OR gate, consisting of diodes (A100) CR13, 14 and 15 at Pin 3, U3. The resultant comparator output pulse at Pin 9 is fed to switch driver transistors Q12 and Q13.

The OR gate takes the larger of three inputs and passes it on to the comparator.

Comparator inputs are as follows:

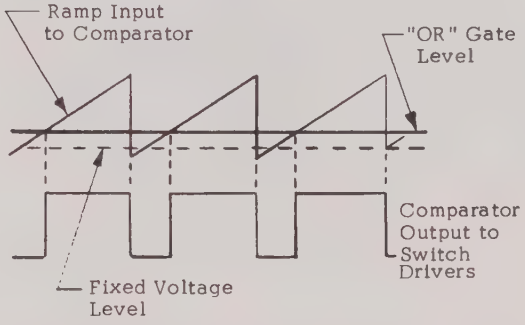
1. A fixed voltage at (the anode of) A100CR14 developed by (A100) VR2, R19 and 20.

2. The error amplifier output at A100CR13, through isolator A100U7E.

3. The current-limiting circuit output developed at A100CR15.

In a typical operating situation, any tendency of the supply output to increase is sensed through error amplifier A100U6. This output controls the OR gate through (A100) U7 and CR13, increasing the gate output to the comparator and thus narrowing the width of the pulse which controls the ON time of switches driver Q18 through Q21.

This function is illustrated in the following diagram:




The fixed voltage at A100CR14 establishes a maximum pluse width (minimum OR output) allowable, to protect switching transistors Q1 through Q4. Wider pulses might conceivably overlap, damaging power transistors Q1 through Q4 by switching both ON at the same time.

4.2.6 Switching Transistors (Figure 5-2)

Switching transistors Q1-Q4 form a push-pull, pulse-width modulated inverter of two parallel branches; Q1/Q3, and Q2/Q4. Q1 and Q2 are driven simultaneously in one phase, and Q3 and Q4 in the other.

As noted previously, switching transistors Q1 through Q4 react to the output of the comparator through their respective drivers Q18 thru Q21. This pulse width modulated wave, with a 40-kHz repetition rate is fed simultaneously to the bases of Q18 through Q21. Only one parallel pair will be activated however, as the collectors of each are connected to secondary E5 and E6 of bias transformer A100T1. Thus, while one is turned ON (+5 volts), the other will be at cut-off (-5 volts). Since the transformer waveform is 20 kHz, synchronized with the comparator, alternate comparator outputs are fed to their switching transistors respectively.

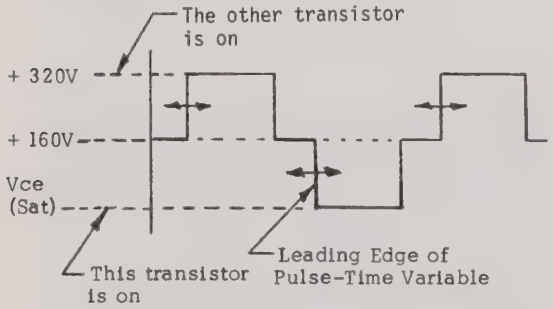
The comparator thus turns on the appropriate drive transistor, which in turn activates the switching transistors. Turn-off of these

transistors is accomplished by diodes CR20 to CR23 in conjunction with bias transformer A100T1. This action results in very rapid turn-off of the switching transistors.

4.2.7 Output Circuits (Figure 5-3)

The switching action of the transistors results in the following string of pulses at the primary of transformer T1: (Pulsewidth determinded by ramp vs. OR gate output). The figure below shows the collector voltage waveform of one transistor in one push-pull inverter. The waveform of the other transistor in the same inverter is the same except $180^{o}$ out of phase.

At the secondary, rectification takes place through CR6A/B (and CR7A/B where used). The resultant signal at a 40-kHz repetition rate is then filtered by L5/C12, and L6/C15, and appears as the supply output voltage at TB2-1 (+) and TB2-2 (-). The integration function of the filtering reduces the 40-kHz component of the output to less than 3 millivolts (RMS).




4.2.8 Reference and Error Amplifiers (Figure 5-6)

Integrated circuits U5/U6 on PCB A100 are the primary components of the reference and error amplifiers respectively. The circuits derive operating power from secondary windings 4, 5 and 6 of bias transformer A100T1. The waveform at the secondary is rectified by (A100) CR28/CR29, and filtered by A100C19. Integrated circuit A100U5 functions as a voltage regulator, and produces a constant 16 Vdc from Pins 7 (+) to 6 (-). This regulated voltage is used to bias error amplifier A100U6, and more importantly, A100VR5, which is the primary voltage reference diode for the supply. The anode of VR3 is connected to the unit positive sense terminal (TB1-1) through R1 and L1 (A) on the A200 PCB.

In a stable condition of supply operation, terminals 2 and 3 of error amplifier A100U6 will be maintained at zero volts. Using these basic assumptions, the voltages at J3-5 and J3-8 will be at zero, and thus the current noted at J3-8 is the sum of those through (A100) R54/R67.

Potentiometer A100R65 has been adjusted to maintain this current at 1.0 milliampere (the unit programming current). This level remains constant until an error (change) voltage is sensed at the supply output. The programming current thus appears at A100U6 Pin 2, and at negative sense terminal TB1-4 through R2, R5, R4 and L1B on the A200 PCB.

Any variation in output voltage is instantly sensed at the error amplifier, and processed through isolator A100U7 to an arm of the OR gate, and ghrough the comparator. Then, as described in paragraph 4.2.6, switching pulses are widened or narrowed as required to counterreact variations in output voltage. Diodes (A100) CR30/CR31 act to protect the error IC circuit from large variations in output voltage. Thus is formed a negative feedback loop consisting of: error amplifier, isolator, OR gate, comparator, switching transistors. T1 (main chassis) and output rectifiers and filters. Compensation is provided in the negative sensing circuit by (A200) C1/R5 together with (A100) C21/R59 to ensure that the loop remains free of oscillations.

4.2.9 Current Limiting Circuit (Figure 5-6)

This circuit, consisting of (A100) U4, CR19 and C10 serves to protect the supply in the event of excessive current demands such as a short-circuited output. By design, a fixed relationship exists between the unit output current and the peak current of switching transistors. Therefore, by limiting peak current, the output current is controlled.

The peak voltage across R2 on the main chassis (due to switching current) is applied to (A100) C10/CR19 through J2-4/J2-2 on the PCB connector. The capacitor peak voltage then, is proportional to the peak output dc currents. A reference (threshold) voltage is developed by (A100) VR2, R28/29/30 and appears at Pin 2 of A100U4. When the voltage at A100C10 exceeds a critical value established by this threshold A100R31/CR18, and consequently A100U4 operates. This action causes the A100CR15 arm of the OR gate to take control of the feedback loop (current limit mode), producing whatever voltage is necessary to restrict the supply output current.

A100CR18 acts as a temperature-compensating diode adding temperature stability to the circuit.

4.2.10 Over-Voltage Protection (OVP) Circuits (figure 5-3)

The OVP circuit senses an over-voltage condition at the output terminals, and acts to fire A100Q11 and shut off all the bias voltage. Either of two circuit designs are used,depending on the level of output voltage. Both are analyzed in the following paragraphs.

4.2.10.1 Supply Outputs to 12 Volts

For these lower voltage supplies, regulator VR1 establishes the over-voltage reference level. Its bias is set by C5/CR1, CR2/CR3/CR4, and Q1 of PCB A200. A sample of this reference appears across potentiometer R9, and presented through temperature-compensating diode CR5 to the gate of programmable unijunction transistor (PUT) Q2. Also at the anode of Q2 is a sample of the output voltage. When this sample exceeds the reference sample at the gate of Q2 by more than approximately 300 mV, Q2 fires. Simultaneously, Q11 on PCB A100 is fired through transformer T2, acting to shut down bias inverter A100Q9/Q10. This has the effect of shutting off the switching transistors on the main chassis. This condition remains until the line voltage is removed.

4.210.2 Supply Outputs of 15 Volts and Greater

For these STM supply outputs, Q2 is a silicon unilateral switch (SUS), used as a triggering device. This device utilizes an internal voltage as the over-voltage reference. When its anode/catnode voltage exceeds this level (approximately 7.5 Vdc), it tires, abruptly reducing its voltage. Unit shutdown occurs through the T2/A100Q11 action described in the previous paragraph.

4.2.11 Radio Frequency Interference (RF1)Control

The switching action of this type of supply might be expected to create a source of RF1. The design of the STM series has minimized this interference, using the limits specified in MIL-STD-461A as a reference.

Conducted interference on the input lines is reduced to acceptable levels by L1/L2/L3 together with C1/C5/C6 on the main chassis. Conducted interference at the output load and sense leads is minimized by L7 and C16/C17. Radiated interference is effectively minimized by the metal enclosure of the STM series power supplies.

# 5 SERVICE AND REPAIR

## 5.1 GENERAL

This section provides unit troubleshooting data, and calibration and performance-testing procedures. The troubleshooting data should be used in conjunction with the schematic diagrams location photos, and previous Section 4 which outlines the theory of operation. Questions pertaining to repair should be directed to the nearest Sorensen service representative or to the Service Dept., Sorensen Company, 676 Island Pond Road, Manchester, N.H. 03103. Include the model and serial numbers in any correspondence. Should it be necessary to return a unit to the factory for repair, authorization from the Sorensen service dept. must be obtained. Sorensen Company will not assume responsibility for units returned without prior authorization.

Unit troubleshooting hints are provided in Tables 5-1 and 5-2 in the form of SYMPTOM/PROBABLE CAUSE/REMEDY. Where practicable, step-by-step procedures are used to facilitate isolation of a problem area.

Care should be taken when replacing any component, even if it appears obviously defective. A failed component is generally the result of a malfunction elsewhere in the system. It is the purpose of this troubleshooting procedure to help isolate both the failed component and the cause of its failure.

## 5.2 PERIODIC SERVICING

It is recommended that STM units be periodically removed from service and cleaned. The enclosure should be inspected and cleaned of dust or debris which could impede the circulation of air.

## 5.3 TEST EQUIPMENT REQUIRED

Use the test equipment listed (or an equivalent)

1. Oscilloscope, dual trace, 20-MHz bandwidth, isolated from ground. (Tektronix 454 with 10X voltage probe for channel A.)

2. 50-ohm, 2-watt load (in series with channel B and current probe);

   Channel B; current probe (tektronix P6042)

3. DVM (Fluke 8400)

4. Differential voltage probe (Tektronix P6046)

5. True RMS voltmeter (Fluke 8400-09)

6. VOM (Simpson 260)

**CAUTION**

1. *Assure that all test equipment used while troubleshooting is NOT GROUNDED, unless an isolation transformer is used for unit input.*

2. *Each time the unit is opened, re-check for input and output isolation to case ground before turn-on.*

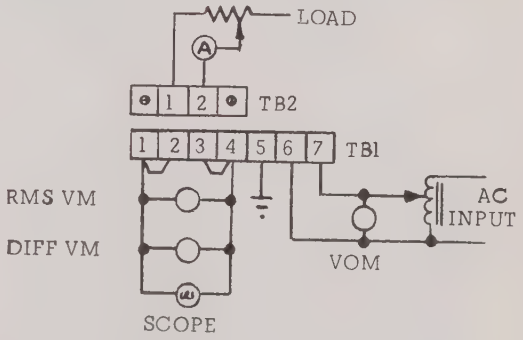



Figure 5-1 Test Equipment Setup

## 5.4 TROUBLESHOOTING

### 5.4.1 General Considerations

Before attempting repairs, the STM unit should be carefully inspected for apparent defects, such as brokern or damaged components/connectors or PCB, or for obvious heat damage or loose pin connections.

After replacing an electrical component, the simulated turn-on procedure outlined in paragraph 5.5.1 should be performed before placing the unit into service.

The physical size and shape of a replacement part can have an effect on the performance of the power supply. The part should therefore be a direct replacement whenever possible. Section 6 of this manual lists replaceable parts along with the Sorensen part numbers as applicable.

5.4.2 Switching Transistors (Q1 through Q4)

**CAUTION**

*The casings of these transistors are "live" during operation.*

In the event power transistors Q1 through Q4, require replacement, the probable cause of failure should be determined before power is applied to the unit. Proceed as follows: (Use test equipment per paragraph 5-3).

1. Remove the case screws of power transistors, isolating the collectors from the circuit.
2. With a VOM set to the R x 1 scale measure an open circuit from TB1-2 (+) to TB2-5 (-) for Module IVAand TB4-1 (+) to TB4-8 (-) for Module VI. These TB's are on the main chassis.
3. Check for line-to-chassis isolation. Read open circuit on VOM set to R x 10K scale.
4. With the VOM, check the drive circuit components on PCB A100, Q12 thru Q25 and CR20 thru CR23 for a possible short.

*NOTE*

*After the cause of failure has been eliminated, proceed to simulated turn-on procedure (paragraph 5.5.1).*

5.4.3 Over-Voltage Protection (OVP) Circuit

Failure in the OVP circuit can generally be traced to an improper adjustment of OVP potentiometer, or one of the following:

1. For units up to 12-volts output; on (A200), Q1, Q2, C11 and A100-Q11 or associated component, (Figure 5-3).
2. For units with 15-volts (or greater) output; A200Q2, A100Q11, or an associated component, (Figure 5-3).

After replacing any component in this section, the OVP should be properly set as outlined in final turn-on procedure (paragraph 5.5.2). If OVP continues to actuate, proceed to PCB A100 troubleshooting in paragraph 5.4.4.

Table 5-1 Main Chassis Troubleshooting

| SYMPTOM | PROBABLE CAUSE | REMEDY |
|---|---|---|
| 1. No output | A. Over-voltage protection circuit tripped (fuse intact). | 1) Reapply input voltage after approximately 30 seconds.<br><br>2) Verify proper setting of OVP trip point accessible through front panel. CW adjustment increases the output voltage trip point. If this adjustment resolves the problem, reset per paragraph 3.3.4 in Section 3 of this manual.<br><br>3) If OVP tripping recurs with normal output loading, or with no output, refer to OVP troubleshooting procedure (paragraph 5.4.3). |
| | B. Current limit improperly adjusted. | If, during unit calibration or repair, potentiometer R28 on PCB A100 has been left in the fully CCW position, no output will appear. Refer to final turn-on procedure (paragraph 5.5.2). |
| | C. Output circuit shorted (fuse not affected). | Check individual output circuit components. |
| | D. A100 control PCB failure (line fuse intact, A100 PCB fuse open) | 1) Replace A100Q9, A100Q10 and associated components. Proceed with simulated turn-on. |
| | E. Input fuse open. | 1) Replace fuse.<br><br>2) For repetetive fuse failures, perform the following checks as necessary.<br><br>a. Remove power and replace fuse.<br><br>b. Connect a VOM (Simpson 260 or equivalent) set to the R x 1 scale between TB1-2 (+) to TB2-5 (-) for Module IVA or TB4-1 (+) to TB4-8 (-) for Module VI (Figure 5-3) (on main chassis). A normal indication is an open circuit condition. If this occurs, continue to paragraph c. following. If a short is indicated (less than 15 ohms), remove the switching transistor case screws, which will isolate the collector(s) from the circuit. Repeat the resistance test for each transistor, collector to emitter. A short indicates a faulty transistor. Replace as necessary.<br><br>*NOTE*<br><br>*After replacing the faulty transistor do not yet insert Q1/Q4 case screws until the probable cause of failure has been determined. Refer to troubleshooting, (paragraph 5.4.2).*<br><br>c. Check for shorted input rectifier CR1 as applicable.<br><br>d. Check for short from input to chassis (TB1-6 or -7 to TB1-7). |

| SYMPTOM | PROBABLE CAUSE | REMEDY |
|---|---|---|
| 1. No output (cont'd) | E. Input fuse open (cont'd). | e. Connect the VOM across input terminals TB1-6 and -7. Remove the A100 control card. If the short is eliminated, proceed to the control PCB troubleshooting procedure (paragraph 5.4.4).<br>f. Check for continuity: (Refer to schematic diagram, Figure 5-3).<br>g. Check and replace faulty component on A100 PCB base drive circuit, especially transistor Q12 through Q25 and diodes CR20 through CR23. |
| | F. Input circuit failure. | Remove case (collector) screws of switching transistors. Proceed to simulated turn-on procedure in paragraph 5.5.1. |
| 2. High output | A. Improper setting of voltage adjust and OVP adjust accessible at front panel. | Reset the adjustments per paragraph 5.5.2 steps 6 through 11. |
| | B. VR5, U5 and U6 on PCB A100. | Check zener voltage A100VR5 for possible high voltage. |
| | C. Defective R2 on PCB A200. | 1) Check continuity in sensing path (see Table 6-1 or 6-2 for proper resistance value).<br>2) Check for possible unit oscillation due to remote programming. |
| 3. Low output | A. Current limit improperly adjusted. | Readjust per final turn-on procedure (paragraph 5.5.2). |
| | B. VR5, U5 and U6 on PCB A100. | 1) Check zener voltage A100VR5 for possible low voltage.<br>2) Refer to control PCB troubleshooting, paragraph 5.4.4. |
| 4. Excessive ripple on output and/or unit oscillate at no load. | A. Low line input. | Monitor input line voltage. |
| | B. L5 & L6 defective. | Visually inspect for signs of deterioration or damage. |
| | C. C12 and/or C15 malfunctioning or defective. | 1) Check for proper tightening of C15 hold-down screws.<br>2) Check C12 and/or C15 for short/open. |
| | D. Unit in current limiting mode. | |
| 5. Poor regulation | A. Measuring across load terminals. | Regulation must be measured across sensing terminals. |
| | B. Unit overload. | Load not to exceed maximum rated current specification. |
| | C. Current limit improperly adjusted. | Refer to adjustment procedure in paragraph 5.5.2. |
| | D. Control PCB A100 | Check PCB per paragraph 5.4.4. |
| | E. Regulator PCB | Check for 110-volt output. |

5.4.4 Control PCB A100

Select required test equipment from the recommended list in paragraph 5.3. Assure that any equipment used is not grounded.

Refer to Figure 5-6 for schematic diagram and location of components; proceed with troubleshooting as outlined in Table 5-2.

**CAUTION**

1. *Remove the switching transistor case (collector) screws before troubleshooting the control PCB.*

2. *After repair or replacement of PCB, continue to simulated turn-on procedure in paragraph 5.5.1.*

5.5 OPERATIONAL CHECKOUT PROCEDURES

Whenever a component is repaired or replaced, the appropriate unit turn-on procedure should be followed before placing the unit into service:

1. Input failure (including PCB A100): perform first the simulated turn-on procedure in paragraph 5.5.1 (transistor case screws removed) and then the final calibration procedure paragraph 5.5.2 (screws re-inserted).

2. Output failure: perform final calibration procedure (paragraph 5.5.2).

5.5.1 Simulated Turn-On Procedure

With the casing (collector) screws removed from switching transistors proceed as follows: (Use the test equipment outlined in paragraph 5.3).

1. With input power OFF, set the current limit control A100R28 fully CCW.

2. Connect the VOM, set to the R x 100 scale, positive lead to the primary terminal TB1-2 (+) to TB2-5 (-) for Module IVA, or TB4-1 (+) to TB4-8 (-) for Module VI (Figure 5-2), noting the capacitor charging effect.

3. Connect the VOM, set to the R x 1 scale, to the output terminals; positive to positive and negative to negative, and note the resistance. Meter will indicate a bleeder resistance according to the unit under test. (See parts list in Section 6 for resistance values.) Reverse the polarity of the VOM. Read forward biased diode in parallel with this resistance.

4. Connect the oscilloscope 10X probe across A100R48. Set the oscilloscope sensitivity to 0.2V/division, timing to 20 usec/division and on the dc scale.

5. Clip the current probe to the common emitter lead of the switching transistors with the current direction (arrow) leaving the transistors into the main PCB (J2-1, orange wire). Set the oscilloscope sensitivity to 1A/division.

6. Momentarily apply, then quickly remove input power. Observe oscilloscope, and adjust as necessary for indication of a clean, square waveform on channel A. Repeat as necessary.

*NOTE*

*Inability to obtain the waveform indicates a malfunction in the control PCB (refer to paragraph 5.4.4).*

7. Place line power to ON. The unit should be working under deep current limiting mode. Check the following: (See waveform pattern "A", Figure 5-2).

   a. The oscillating square wave repetition should be from 45 to 60 microseconds.

   b. The peak level of the square waveform is at 0 volt, and the lower level is from (-)4 to (-)6.5 volts.

c. Repeat voltage check on all four base drive circuits across R49, R50 and R51. No current will be detected by the current probe on channel B; only some very thin switching spikes of no significant magnitude should be evident.

8. Slowly adjust A100R28 CW. On the oscilloscope, the presence of a full-duty cycle will be observed. (See waveform patterns "B" and "C", Figure 5-2). If A100R28 has no control over the duty cycle, check CR18/CR19 or C10. For resolution of the duty cycle, SHUNT R33 and C11 with a 100k resistor to reduce the amplifier gain.

9. Check that the current waveform in pattern "C" has twice the repetition rate of the voltage waveform "B", and also note that current pulses are reasonably similar in amplitude. If both of these events are not as stated, check the transistor drive circuit components.

10. Reduce line voltage to observe snap-on action. Snap-on failure will cause output voltage to overshoot and fire the OVP.

*NOTE*

*The procedure to this point verifies the proper functioning of the input drive and power transistor circuits. Continue only when the conditions of steps 7, 8 and 9 have been satisfied.*

Table 5-2 Control Board A100 Troubleshooting

| SYMPTOM | PROBABLE CAUSE | REMEDY |
|---|---|---|
| 1. No output, PCB fuse intact | A. Snap-on circuit. | 1) Check bias voltage (16.7V).<br>2) Replace any faulty component of U1, Q1, Q2, Q3, VR1, VR2 and associated components. |
| | B. Ramp generator circuit | 1) Check bias voltage of VR3 (4 to 4.7V depending on whether the MV is on or off).<br>2) Replace any faulty component of VR3, Q5, C32 and associated components. |
| | C. Multivibrator circuit | 1) Check flip-flop output to the base of Q9 and Q10.<br>2) Replace Q7 and Q8. |
| | D. OVP circuit. | Replace Q11. |
| 2. No output, PCB fuse open | Inverter circuit | Replace Q9 and Q10 and/or Q7 and Q8. |
| 3. Low unit output | Reference error amplifier | Measure approximately 16 Vdc from cathode of VR5(+) to TP1(-). If 16 volts appears, replace U6. If greater than 16 volts, replace VR5. If less than 16 volts, replace U5 and/or VR5.<br>At NO LOAD and at minimum rated output, measure approximately 9 Vdc from TP2(+) to TP1(-). DO NOT APPLY LOAD WITH TEST METER CONNECTED. |
| 4. Output drifting | Refer to probable cause and remedy of symptom 3. | |
| 5. Poor unit regulation | Refer to probable cause and remedy of symptom 3. | |
| 6. OVP actuates repeatedly | A. Refer to 5.4.3 | Check and replace if necessary. |
| | B. Refer to probable cause and remedy of symptom 1A and 3. | |

11. Re-insert switching transistor (collector) screws. Connect a VOM, set to the R x 10k scale, from case to chassis. Read open circuit.

5.5.2 Final Calibration Procedure

If the switching transistors and/or drive circuit components have been changed, perform tests per paragraph 5.5.1 before continuing.

1. Remove input power and connect test equipment as in step 4 of previous paragraph 5.5.1.

2. Clip current probe on two #18 purple wires at TB1-2 for Module IVA or at TB4-1 for Module VI, with current direction leaving the terminal.

3. Connect the dc differential voltmeter and rms voltmeter across the output sensing terminals (TB1-1 and -4).

4. On front panel, set the output voltage control to its approximate mid-range, and the OVP control fully CW.

5. Remove load from output.

6. Set current limit adjust A100R28 fully CCW.

7. Apply nominal input power and turn A100R28 slowly CW. The output voltage should increase and the current waveform on oscilloscope channel B should appear as in pattern "D" of Figure 5-2.

*NOTE*

*At this point, three phenomena should be carefully watched:*

a. If there is a short in the power transformer (T1) primary winding, the current waveform will have alternate duty cycle pulses missing when the unit is out of current limiting.

b. If there is a short at the secondary winding or at the output, the current will appear as high pulses.

7. Gradually apply full rated load current. Note the main conducting portion of any two adjacent emitter current waveforms as indicated in pattern "D" of Figure 5-2.

8. Set current limit control A100R28 at 110% of rated full-load current (per Table 1-1B/C).

9. Remove output load current. Set output voltage control to 110% of rated output voltage (per Table 1-1B/C).

10. Slowly turn OVP control CCW until it shuts the unit off.

11. Turn voltage control potentiometer at least one full turn CCW, and remove input voltage. After 1 minute, re-apply input, and adjust for rated output voltage.

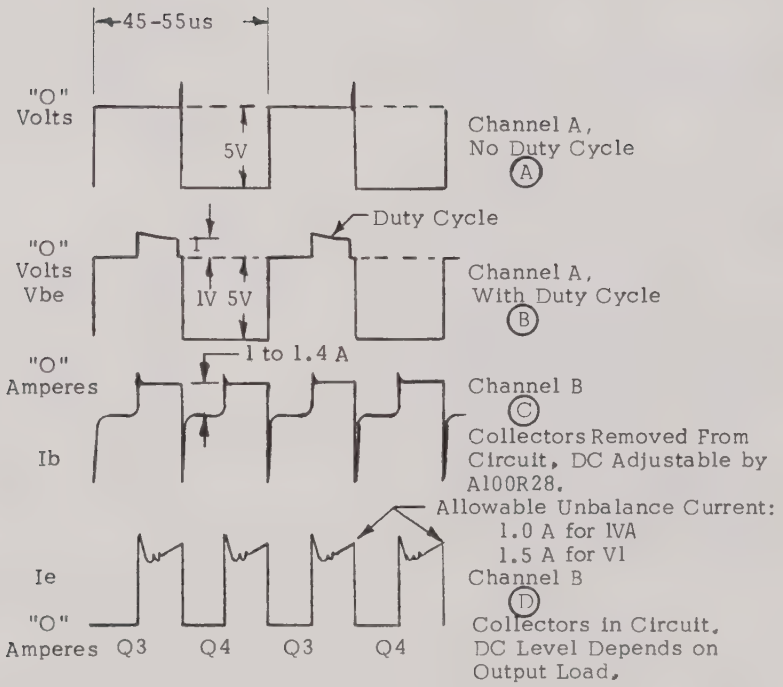



Figure 5-2 Switching Transistor Waveforms

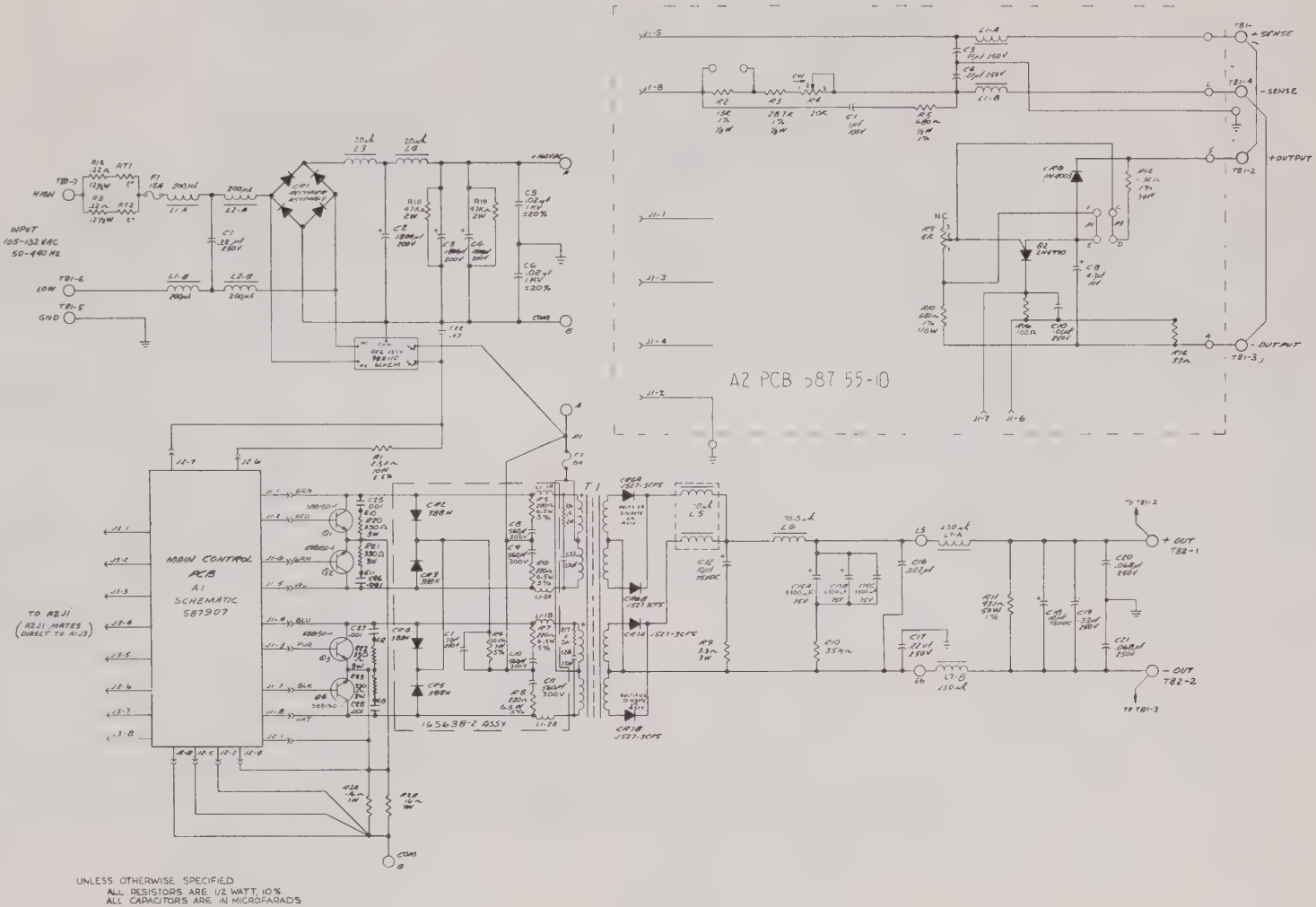







Figure 5-3 STM Units Typical Schematic Diagram

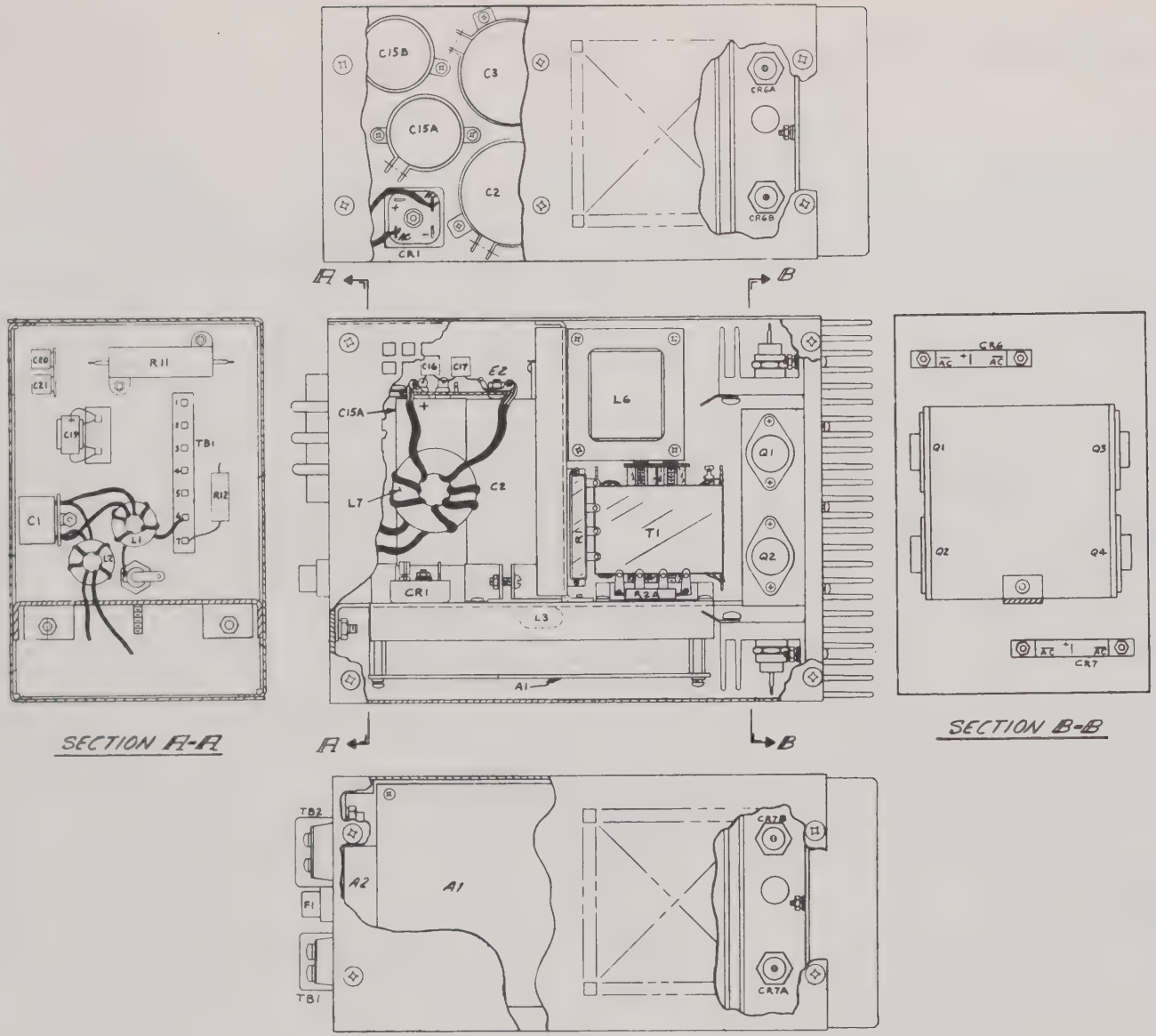



Figure 5-4 Module IVA-Typical Component Location

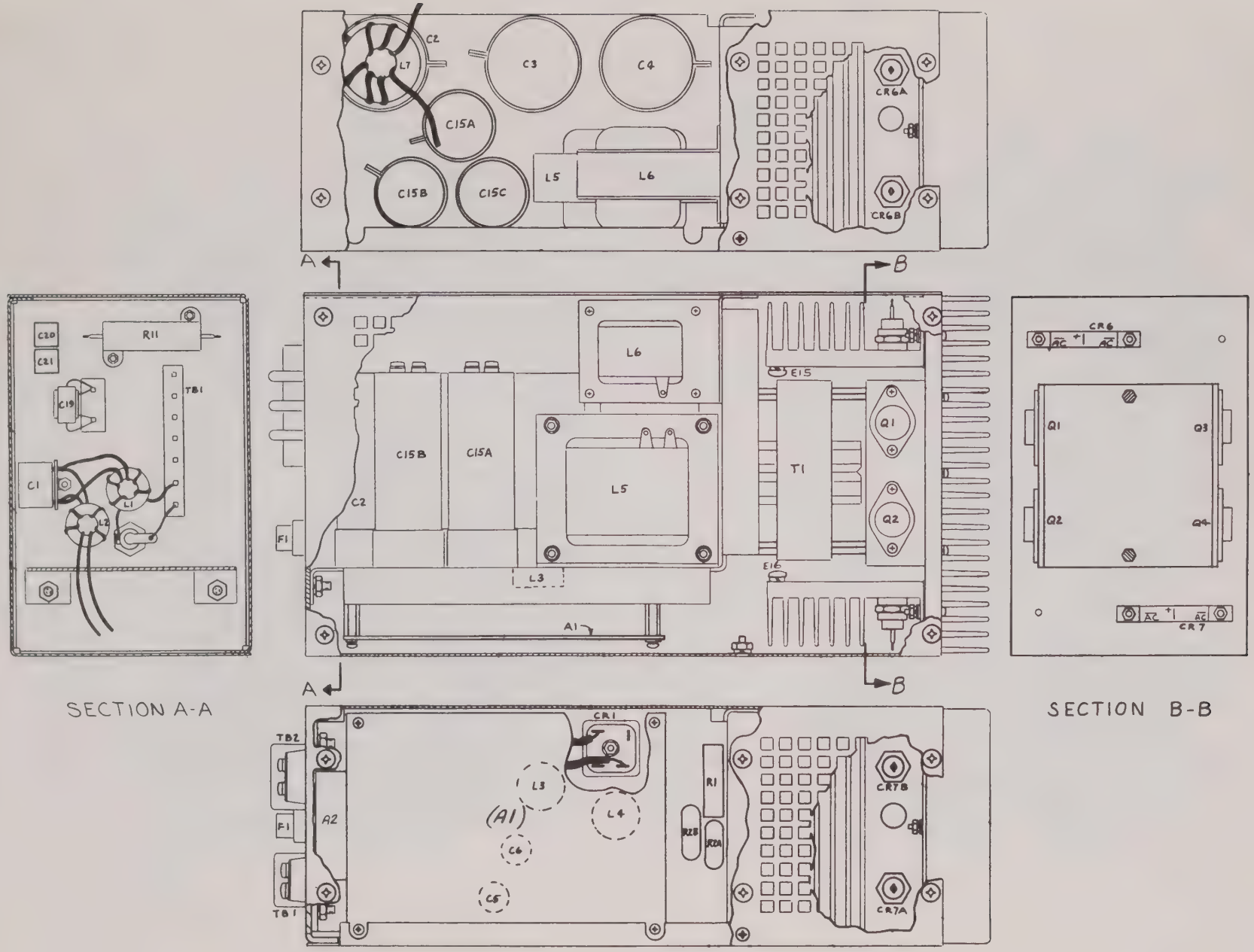
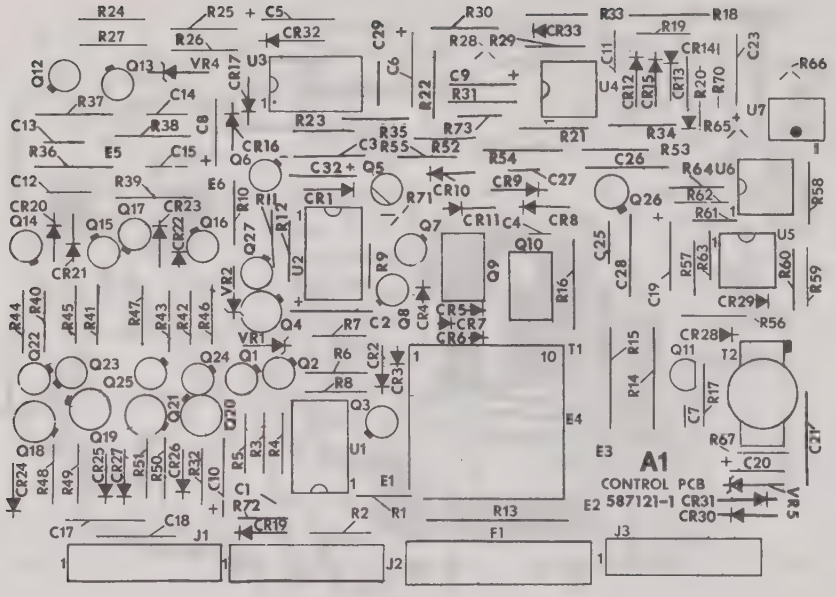
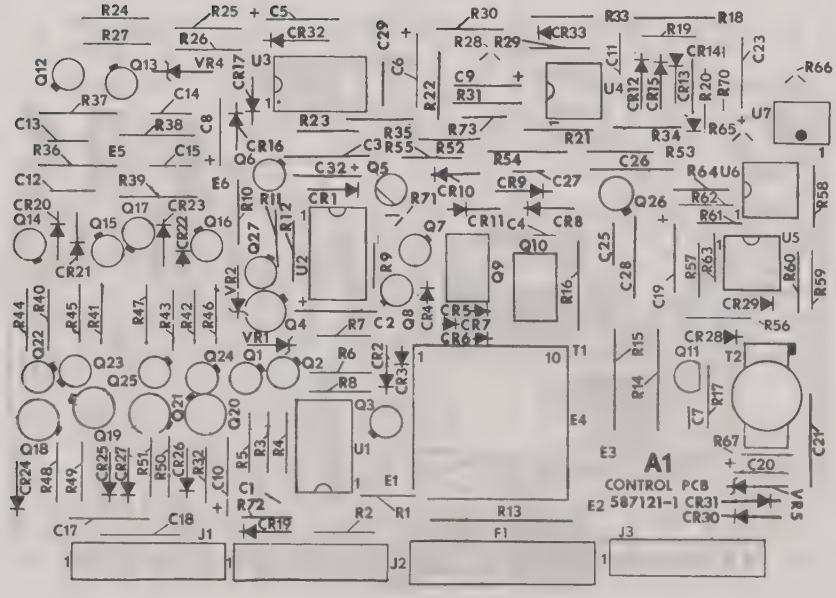



Figure 5-5 Module VI-Typical Component Location




Component Side




Solder Side

Figure 5-6A Printed Circuit Board A100-Typical Assy

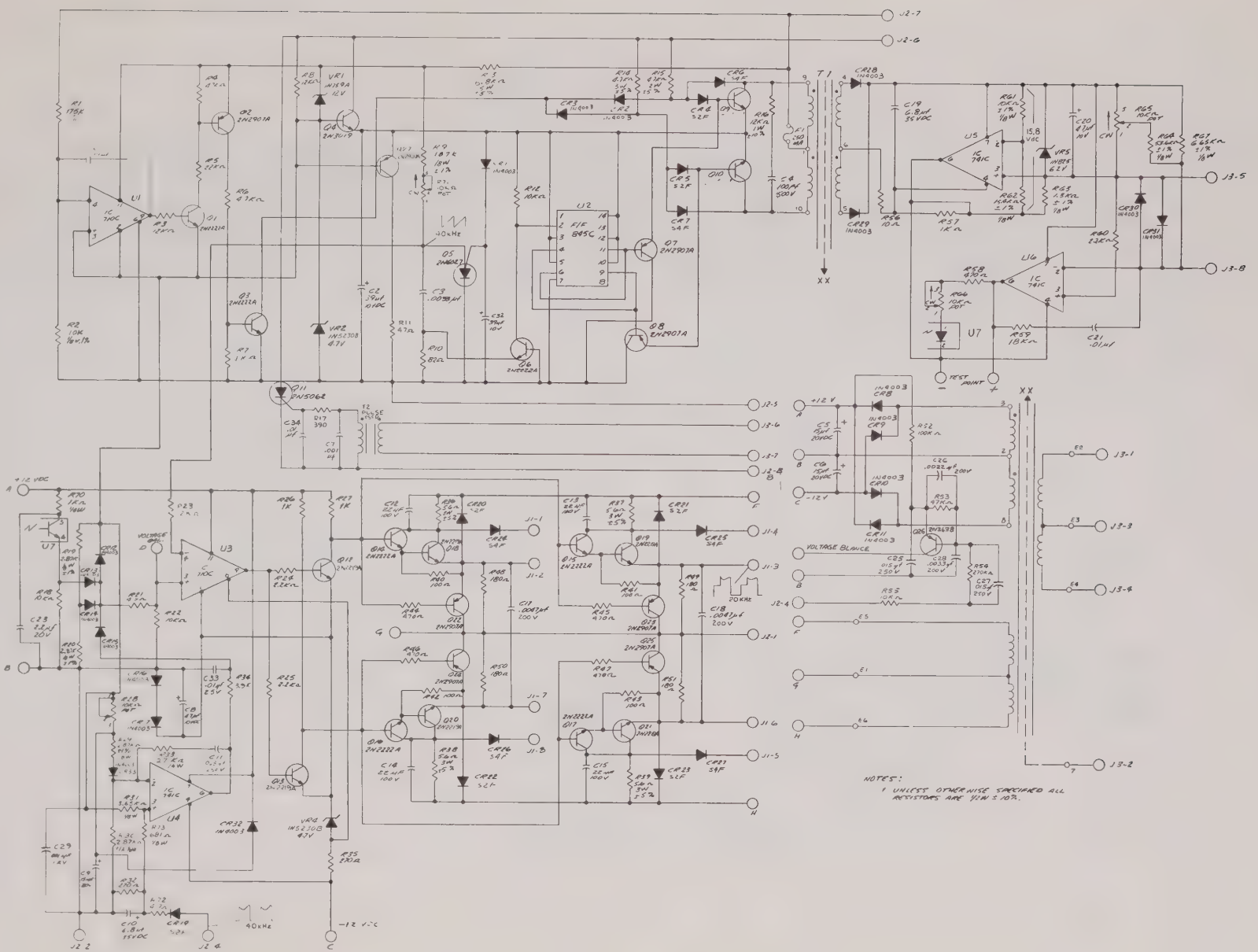







Figure 5-6B Printed Circuit Board
A100 Schematic Diagram

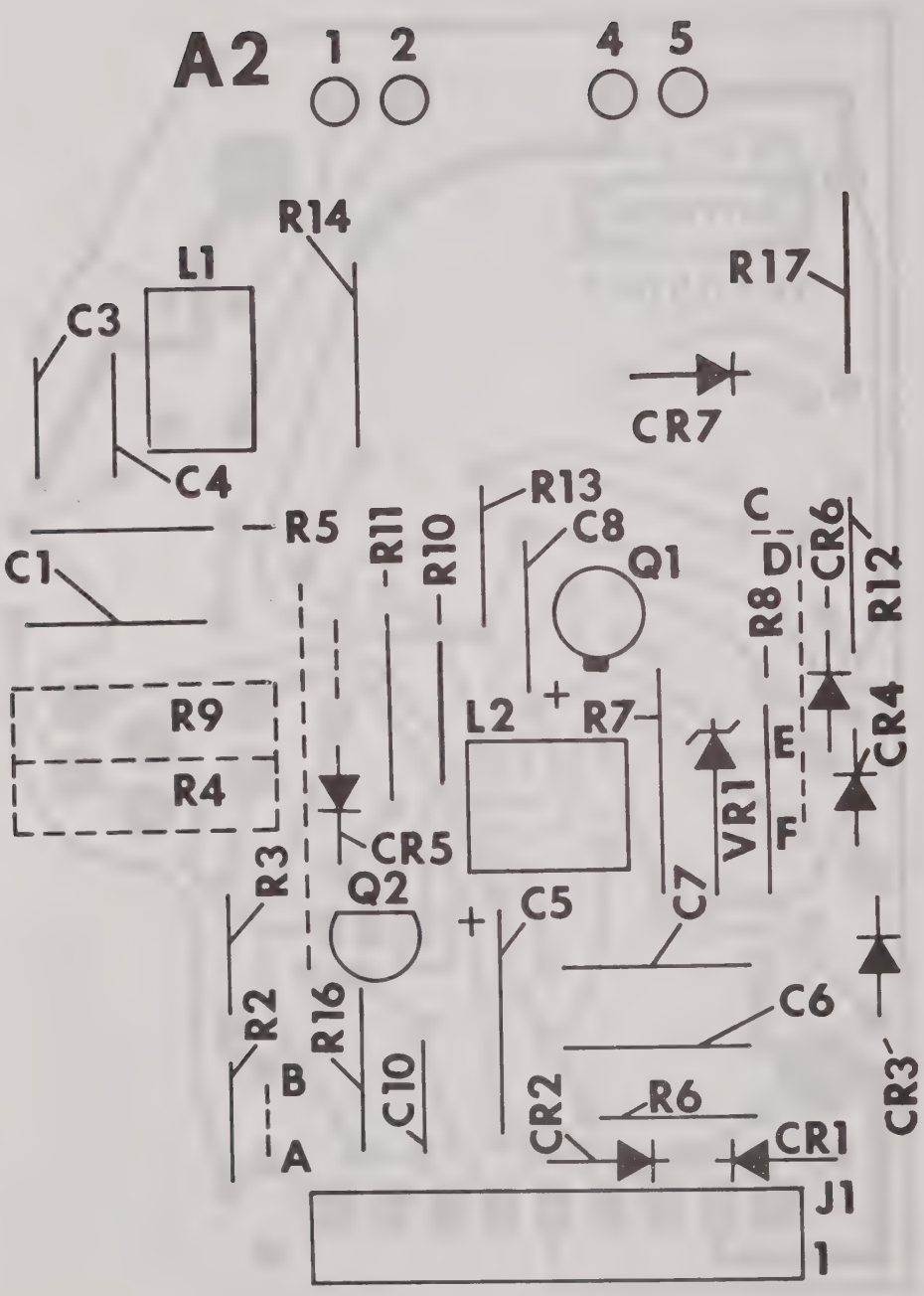
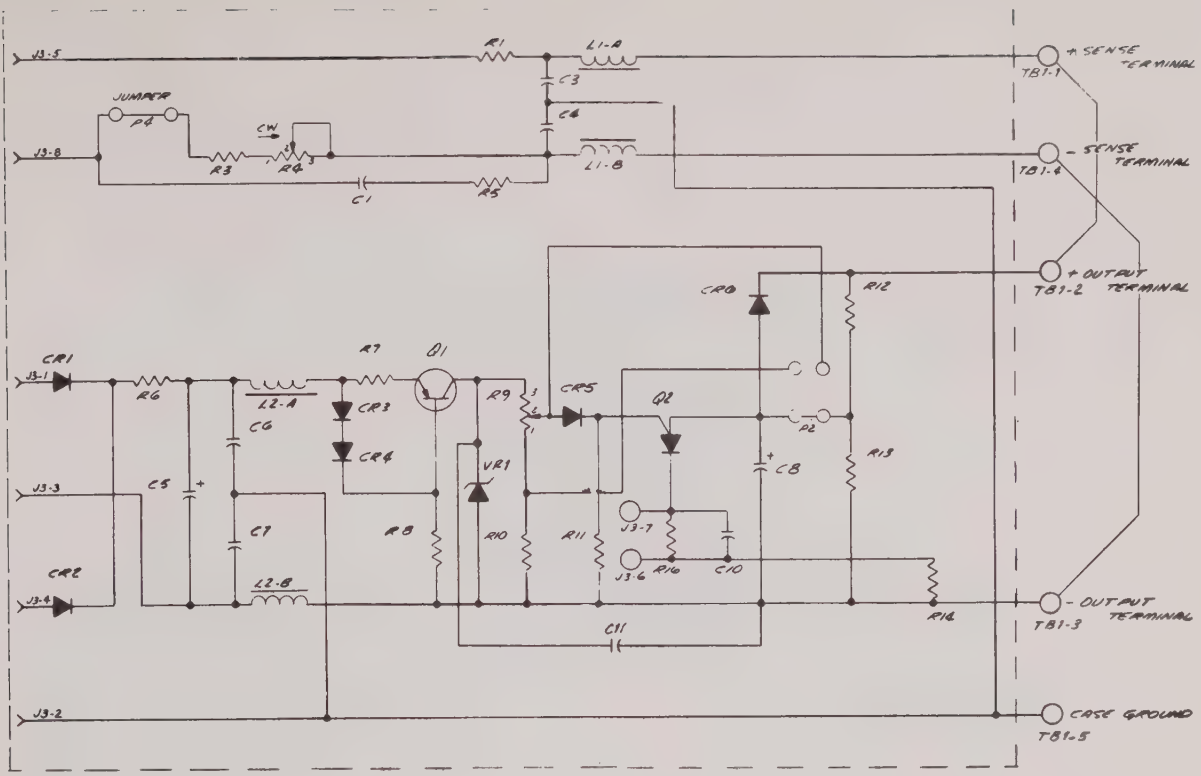
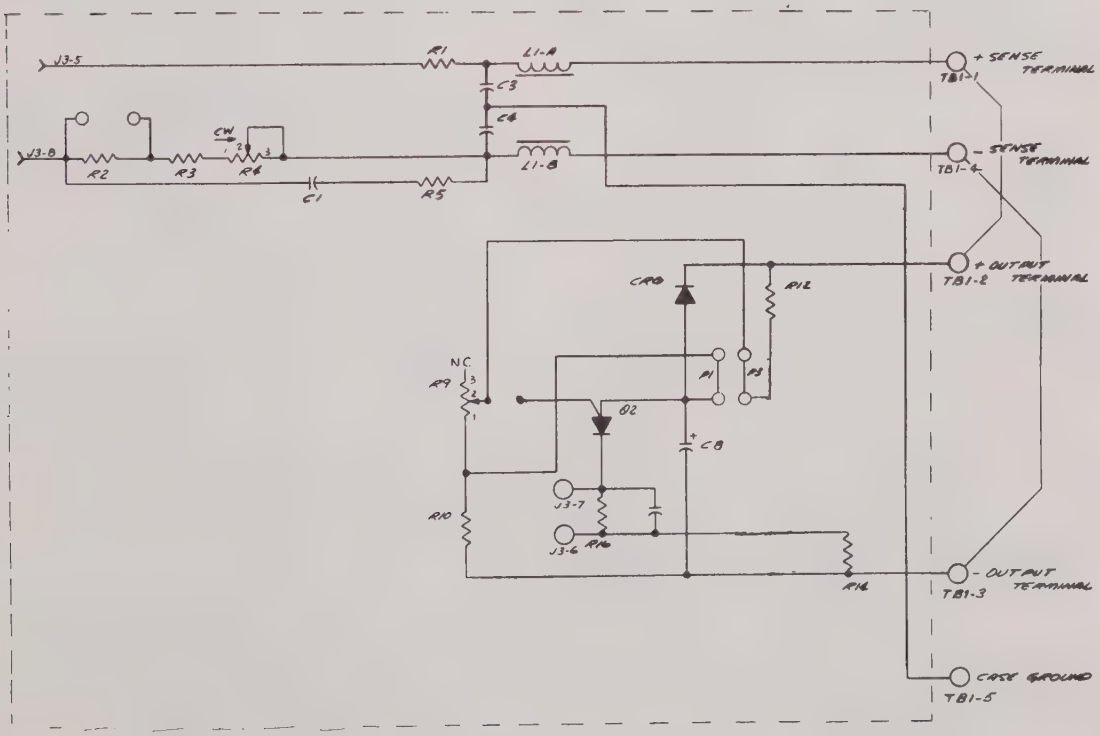



Figure 5-7A Typical A200 PCB Assy

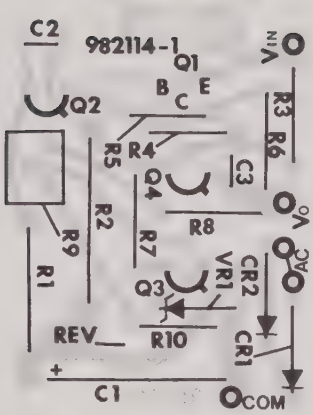



3-12 Volt




15-48 Volt

Figure 5-7B Typical A200 PCB Schematic



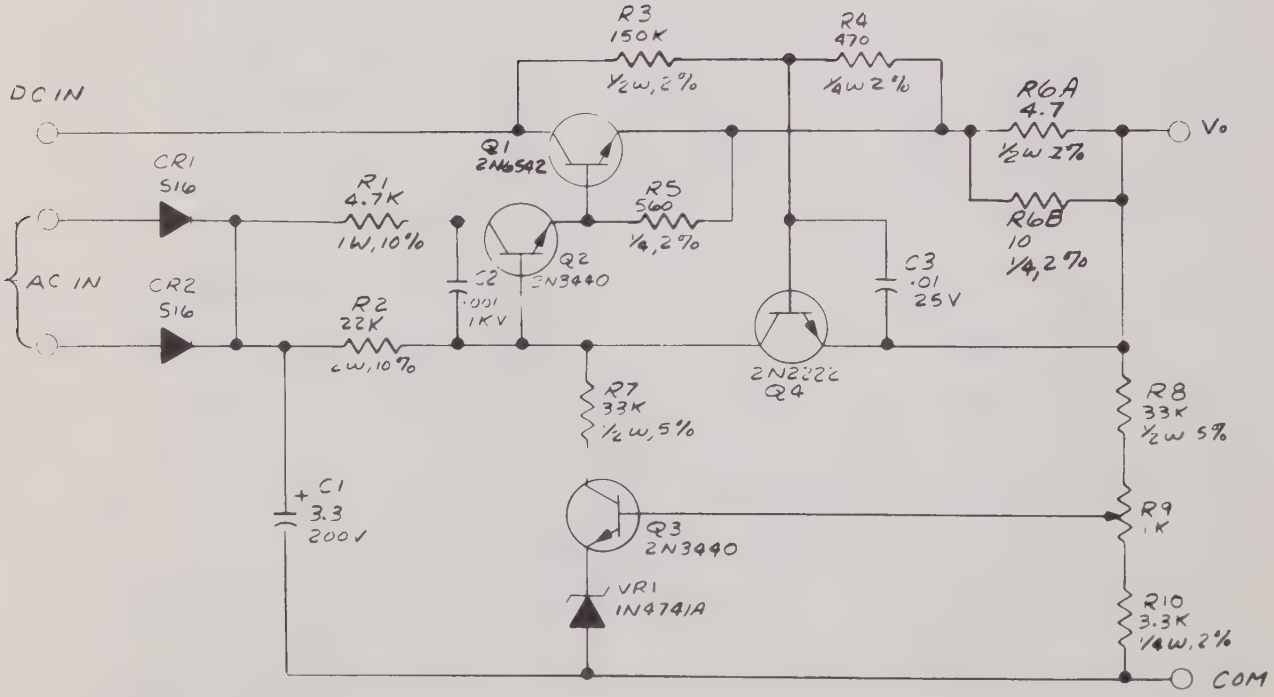




Figure 5-8
Regulator Printed-Circuit Board
Schematic and Assembly
Drawings

# 6 REPLACEABLE PARTS LISTS

## 6.1 INTRODUCTION

This section provides a coded replaceable parts list for the STM module sizes IVA and VI, keyed to the schematic and parts location diagrams appearing in section 5. Table 6-1 covers all main assembly components in the module IVA group, while table 6-2 covers the module VI group. Table 6-3 and 6-4 lists replaceable parts for the A-200 output printed circuit board assembly and table 6-5 covers the A-100 control printed circuit assembly. Finally table 6-6 covers the components contained in the preregulator printed circuit assembly.

## 6.2 TABLE HEADINGS DEFINED

### 6.2.1 Circuit Symbol

This is an alpha-numeric identification of the component as called out on the unit drawings and schematics.

### 6.2.2 Sorensen P/N

This number should be used when ordering parts directly from:

Sorensen Company
Replacement Parts Dept.
676 Island Pond Road
Manchester, N. H. 03103

### 6.2.3 Mfr., Type

This is the basic group or series under which the part is listed by a manufacturer. The coded identification of representative manufacturers is summarized below, listed alphabetically.

| Mfr. Code | Manufacturer |
|---|---|
| AB | Allen Bradley Co. |
| AM | Ammons Instrument Co. |
| AX | Acushnet Capacitor Co. |
| BNS | Bourns, Incorporated |
| BUS | Bussman Mfg./Div. McGraw-Edison |
| CD | Cornell-Dublier Corp. |
| CG | Corning Glass Works |
| CL | Clarostat Corp. |
| CTS | CTS Corporation |
| ELA | Electra/Midland |
| EMC | Electromotive Manufacturing Co. |
| GE | General Electric Co. |
| GI | General Illuminating Co. |
| IND | Industrial Devices |
| IRC | International Resistance Co. |
| KEM | Kemet Division Union Carbide Corp. |
| KC | Keystone Carbon |
| LF | Littelfuse Corporation |
| MA | Motorola |

| Mfr. Code | Manufacturer |
|---|---|
| MAL | P. R. Mallory Co. |
| NS | National Semiconductor |
| RAM | RAM Electronics |
| RCA | RCA Corporation |
| RCL | RCL Electronics |
| RDM | Radio Material Co./Div. P. R. Mallory |
| SAN | Sangamo Electric |
| SE | Seacor, Incorporated |
| SEM | Semtech Corporation |
| SP | Sprague Electric |
| SR | Sorensen Company |
| ST | Solitron Devices |
| STM | STM Corporation |
| TEL | Teledyne Semiconductor Division |
| TI | Texas Instruments |
| TRW | TRW Electronic |
| UC | Union Carbide |
| WH | Westinghouse Semiconductor Division |
| WL | Ward Leonard |

Table 6-1
Replaceable Parts List
STM Module IVA

| CIRCUIT SYMBOL | STM Model 3.5-60 | 5-60 | 9-30 | 12-30 | 15-24 | 18-24 | 24-21 | 28-18 | 36-10 | 48-10 | DESCRIPTION | SORENSEN PART NUMBER | MANUFACTURER, TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Capacitors (uF unless Noted) | | |
| C1 | X | X | X | X | X | X | X | X | X | | 0.22, 250V | 587626-67 | SE, 105 |
| C2 | X | X | X | X | X | X | X | X | X | | 1800, 200V | 587192-1 | CD, FAH |
| C3 | X | X | X | X | X | X | X | X | X | | 1800, 200V | 587192-1 | CD, FAH |
| C5 | X | X | X | X | X | X | X | X | X | | .02, 1KV | 24-2029 | SP, C023 |
| C6 | X | X | X | X | X | X | X | X | X | | .02, 1KV | 24-2029 | SP, C023 |
| *C7 | X | X | X | X | X | X | X | X | X | | .22, 250V | 24-2015-17 | SE, MMK |
| *C8 | X | X | X | X | X | X | X | X | X | | 560pF, 300V | 235-7053P317 | EMC, DM15 |
| *C9 | X | X | X | X | X | X | X | X | X | | 560pF, 300V | 235-7053P317 | EMC, DM15 |
| *C10 | X | X | X | X | X | X | X | X | X | | 560pF, 300V | 235-7053P317 | EMC, DM15 |
| *C11 | X | X | X | X | X | X | X | X | X | | 560pF, 300V | 235-7053P317 | EMC, DM15 |
| *C12 | X | X | | | | | | | | | 220, 10V | 586057-10 | UC, MIL-C-39003 |
| | | | X | X | | | | | | | 100, 20V | 586385-10 | UC, T110 |
| | | | | | X | X | X | | | | 47, 35V | 586058-27 | UC, MIL-C-39003 |
| | | | | | | | | X | | | 18, 50V | 585071-44 | UC, MIL-C-39003 |
| | | | | | | | | | X | X | 10, 75V | 586386-8 | UC, MIL-C-39003 |
| C13 | X | X | X | X | | | | | | | .0015, 200V | 24-2409-2 | AX, V146XR |
| | | | | | X | X | X | X | X | | Not Used | | |
| C14 | X | X | | | | | | | | | .0015, 200V | 24-2409-2 | AX, V146XR |
| | | | X | X | X | X | X | X | X | | Not Used | | |
| C15A | X | X | X | X | X | X | | | | | 9000, 25V | 587193-1 | SAN, 100 |
| | | | | | | | X | X | | | 5200, 40V | 587193-2 | SAN, 100 |
| | | | | | | | | | X | X | 3300, 75V | 24-2593-2 | SAN, 500 |
| C15B | X | X | | | | | | | | | 9000, 25V | 587193-1 | SAN, 100 |
| | | | X | X | X | X | X | X | | | Not Used | | |
| | | | | | | | | | X | X | 3300, 75V | 24-2593-2 | SAN, 500 |
| C16 | X | X | X | X | X | X | X | X | X | X | 0.022, 200V | 24-2409-9 | AX, V146XR |
| C17 | X | X | X | X | X | X | X | X | X | X | 0.22, 250V | 587626-99 | SE, 105 |
| C18 | X | X | | | | | | | | | 220, 10V | 586057-10 | UC, MIL-C-39003 |
| | | | X | X | | | | | | | 100, 20V | 586385-10 | UC, T110 |
| | | | | | X | X | X | | | | 47, 35V | 586058-27 | UC, MIL-C-39003 |
| | | | | | | | | X | | | 18, 50V | 585071-44 | UC, MIL-C-39003 |
| | | | | | | | | | X | X | 10, 75V | 586386-8 | UC, MIL-C-39003 |
| C19 | X | X | X | X | X | X | X | X | X | X | 0.33, 250V | 587626-68 | SE, 105 |
| C20 | X | X | X | X | X | X | X | X | X | X | 0.068, 250V | 587626-63 | SE, 105 |
| C21 | X | X | X | X | X | X | X | X | X | X | 0.068, 250V | 587626-63 | SE, 105 |
| C22 | X | X | X | X | X | X | X | X | X | X | 0.47, 250V | 587626-69 | SE, 105 |
| C23 | X | X | | | | | | | | | Not Used | | |
| | | | X | X | X | X | X | X | X | X | 270pF, 500V | 235-7053P297 | EMC, DM15 |
| C24 | X | X | | | | | | | | | Not Used | | |
| | | | X | X | X | X | X | X | X | X | 270pF, 500V | 235-7053P297 | EMC, DM15 |
| C25 | X | X | X | X | X | X | X | X | X | X | 0.001, 1.5KV | 235-7355P316 | EMC, DM20 |
| C26 | X | X | X | X | X | X | X | X | X | X | 0.001, 1.5KV | 235-7355P316 | EMC, DM20 |
| C27 | X | X | X | X | X | X | X | X | X | X | 0.001, 1.5KV | 235-7355P316 | EMC, DM20 |
| C28 | X | X | X | X | X | X | X | X | X | X | 0.001, 1.5KV | 235-7355P316 | EMC, DM20 |

*P/O PCB Ass'y 165638

Table 6-1
Replaceable Parts List
STM Module, IVA
(cont'd)

| CIRCUIT SYMBOL | STM Model 3.5-60 | 5-60 | 9-30 | 12-30 | 15-24 | 18-24 | 24-21 | 28-18 | 36-10 | 48-10 | DESCRIPTION | SORENSEN PART NUMBER | MANUFACTURER, TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Resistors (ohms, 1/2W, 10%, unless Noted) | | |
| R1 | X | X | X | X | X | X | X | X | X | | 2.5K, 10W, 5% | 27-524 | WL, 10F2500 |
| R2A | X | X | | | | | | | | | 0.39, 6.5W, 5% | 586054-8 | RCL, T5 |
| | | | X | X | X | X | | | | | 0.33, 6.5W, 5% | 586054-7 | RCL, T5 |
| | | | | | | X | X | X | X | | 0.27, 6.5W, 5% | 586054-6 | RCL, T5 |
| R2B | X | X | | | | | | | | | 0.39, 6.5W, 5% | 586054-8 | RCL, T5 |
| | | | X | X | X | X | | | | | 0.33, 6.5W, 5% | 586054-7 | RCL, T5 |
| | | | | | | X | X | X | X | | 0.27, 6.5W, 5% | 586054-6 | RCL, T5 |
| *R4 | X | X | X | X | X | X | X | X | X | | 20K, 6W, 5% | 167397-1 | Sage, 1550S |
| *R5 | X | X | X | X | X | X | X | X | X | | 220, 6.5W, 5% | 586054-41 | RCL, T5 |
| *R6 | X | X | X | X | X | X | X | X | X | | 220, 6.5W, 5% | 586054-41 | RCL, T5 |
| *R7 | X | X | X | X | X | X | X | X | X | | 220, 6.5W, 5% | 586054-41 | RCL, T5 |
| *R8 | X | X | X | X | X | X | X | X | X | | 220, 6.5W, 5% | 586054-41 | RCL, T5 |
| R9 | X | X | | | | | | | | | 0.1, 3W | 27-397-1 | WL, 3X |
| | | | X | X | | | | | | | 0.22, 3W | 27-397-9 | WL, 3X |
| | | | | | X | X | X | X | | | 0.56, 3W | 27-397-19 | WL, 3X |
| | | | | | | | | X | X | | 3.3, 3W | 27-397-37 | WL, 3X |
| R10 | X | X | | | | | | | | | 4.69 milliohms | 588004-5 | SR |
| | | | X | X | X | X | | | | | 8.5 milliohms | 588004-3 | SR |
| | | | | | | X | X | | | | 16.25 milliohms | 588004-7 | SR |
| | | | | | | | | X | X | | 16.25 milliohms | 588004-6 | SR |
| R11 | X | | | | | | | | | | 2.49, 50W | 586677-505 | RCL, AL-50 |
| | | X | | | | | | | | | 3.48, 50W | 586677-509 | RCL, AL-50 |
| | | | X | | | | | | | | 7.5, 50W | 586677-515 | RCL, AL-50 |
| | | | | X | | | | | | | 15, 50W | 586677-518 | RCL, AL-50 |
| | | | | | X | | | | | | 20, 50W | 586677-520 | RCL, AL-50 |
| | | | | | | X | | | | | 22.1, 50W | 586677-521 | RCL, AL-50 |
| | | | | | | | X | | | | 28, 50W | 586677-523 | RCL, AL-50 |
| | | | | | | | | X | | | 40.2, 50W | 586677-528 | RCL, AL-50 |
| | | | | | | | | | X | | 86.6, 50W | 586677-568 | RCL, AL-50 |
| | | | | | | | | | | X | 121, 50W | 586677-534 | RCL, AL-50 |
| R14 | X | X | X | X | | | | | | | 10, | 280-1145P2 | AB, EB |
| | | | | | X | X | X | X | x | x | Not Used | | |
| R15 | X | X | X | X | | | | | | | 10, | 280-1145P2 | AB, EB |
| | | | | | X | X | X | X | X | X | Not Used | | |
| R16 | X | X | | | | | | | | | Not Used | | |
| | | | X | X | X | X | X | X | X | X | 1K, 2W | 280-1147P74 | AB, HB |
| R17 | X | X | | | | | | | | | Not Used | | |
| | | | X | X | X | X | X | X | X | X | 1K, 2W | 280-1147P74 | AB, HB |
| R18 | X | X | X | X | X | X | X | X | X | X | 47K, 2W | 280-1147P134 | AB, HB |
| R19 | X | X | X | X | X | X | X | X | X | X | 47K, 2W | 280-1147P134 | AB, HB |
| R20 | X | X | X | X | X | X | X | X | X | X | 330, 2W | 27-397-85 | WL, 3X |
| R21 | X | X | X | X | X | X | X | X | X | X | 330, 2W | 27-397-85 | WL, 3X |
| R22 | X | X | X | X | X | X | X | X | X | X | 330, 2W | 27-397-85 | WL, 3X |
| R23 | X | X | X | X | X | X | X | X | X | X | 330, 2W | 27-397-85 | WL, 3X |
| RT1 | X | X | X | X | X | X | X | X | X | X | Thermistor | 165541-1 | KC, RL10007 |
| RT2 | X | X | X | X | X | X | X | X | X | X | Thermistor | 165541-1 | KC, RL10007 |
| | | | | | | | | | | | Transformers | | |
| T1 | X | X | | | | | | | | | Ass'y | 588196-1 | SR |
| | | | X | X | | | | | | | Ass'y | 588196-2 | SR |
| | | | | | X | X | | | | | Ass'y | 588196-3 | SR |
| | | | | | | | X | | | | Ass'y | 588196-4 | SR |
| | | | | | | | | X | | | Ass'y | 588196-5 | SR |
| | | | | | | | | | X | X | Ass'y | 588196-6 | SR |

*P/O PCB Ass'y 165638-2

Table 6-1
Replaceable Parts List
STM Module, IVA
(cont'd)

| CIRCUIT SYMBOL | STM Model 3.5-60 | 5-60 | 9-30 | 12-30 | 15-24 | 18-24 | 24-21 | 28-18 | 36-10 | 48-10 | DESCRIPTION | SORENSEN PART NUMBER | MANUFACTURER, TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Diodes | | |
| CR1 | X | X | X | X | X | X | X | X | X | X | Bridge, 25A, 400V | 980893-3 | VARO, K013 |
| *CR2 | X | X | X | X | X | X | X | X | X | X | A114D | 586379-6 | GE |
| *CR3 | X | X | X | X | X | X | X | X | X | X | A114D | 586379-6 | GE |
| *CR4 | X | X | X | X | X | X | X | X | X | X | A114D | 586379-6 | GE |
| *CR5 | X | X | X | X | X | X | X | X | X | X | A114D | 586379-6 | GE |
| CR6A | X | X | | | | | | | | | 1N3899 | 588097-1 | WH |
| | | | X | X | | | | | | | 1N3900 | 588097-2 | WH |
| | | | | | X | X | X | X | | | SCPA2F | 586462-3 | SEM, |
| | | | | | | | | | X | X | SCPA3F | 586462-4 | SEM, |
| CR6B | X | X | | | | | | | | | 1N3899 | 588097-1 | WH |
| | | | X | X | | | | | | | 1N3900 | 588097-2 | WH |
| | | | | | X | X | X | X | X | X | Not Used | | |
| CR7A | X | X | | | | | | | | | 1N3899 | 588-97-1 | WH |
| | | | X | X | | | | | X | X | Not Used | | |
| | | | | | X | X | X | X | | | SCPA2F | 586462-3 | SEM |
| CR7B | X | X | | | | | | | | | 1N3899 | 588097-1 | WH |
| | | | X | X | X | X | X | X | X | X | Not Used | | |
| F1 | X | X | X | X | X | X | X | X | X | X | Fuse 10A, 32V | 42-843 | BUS, AGC-10 |
| F2 | X | X | X | X | X | X | X | X | X | X | Fuse 6A, 250V | 226-7176P58 | LF, MTH |
| XF1 | | | | | | | | | | | | | |
| | | | | | | | | | | | Inductors (uH unless Noted) | | |
| L1A | X | X | X | X | X | X | X | X | X | X | 200 | 587181-1 | SR |
| L1B | X | X | X | X | X | X | X | X | X | X | 200 | 587181-1 | SR |
| **L1-1A | X | X | X | X | X | X | X | X | X | X | Ass'y | 165637-1 | SR |
| **L1-1B | X | X | X | X | X | X | X | X | X | X | Ass'y | 165637-1 | SR |
| L2A | X | X | X | X | X | X | X | X | X | X | 200 | 587181-3 | SR |
| L2B | X | X | X | X | X | X | X | X | X | X | 200 | 587181-3 | SR |
| L3 | X | X | X | X | X | X | X | X | X | X | 20 | 587156-1 | SR |
| L4 | X | X | X | X | X | X | X | X | X | X | 20 | 587156-2 | SR |
| L5 | X | X | | | | | | | | | 49 | 588116-1 | SR |
| | | | X | X | | | | | | | 200 | 588116-2 | SR |
| | | | | | X | X | | | | | 300 | 588116-3 | SR |
| | | | | | | | X | | | | 380 | 588116-4 | SR |
| | | | | | | | | X | | | 420 | 588116-5 | SR |
| | | | | | | | | | X | X | 1.42mH | 588116-6 | SR |
| L6 | X | X | | | | | | | | | 3.2 | 588169-1 | SR |
| | | | X | X | | | | | | | 7.05 | 588169-2 | SR |
| | | | | | X | X | X | | | | 15 | 588169-3 | SR |
| | | | | | | | | X | | | 39.2 | 588169-4 | SR |
| | | | | | | | | | X | X | 70.5 | 588169-5 | SR |
| L7 | X | X | | | | | | | | | 33 | 166172-1 | SR |
| | | | X | X | X | X | X | X | | | 90 | 166173-1 | SR |
| | | | | | | | | | X | X | 230 | 166174-1 | SR |
| | | | | | | | | | | | Transistors | | |
| Q1 | X | X | X | X | X | X | X | X | X | X | 2N6308 | 589698-3 | MA |
| Q2 | X | X | X | X | X | X | X | X | X | X | 2N6308 | 589698-3 | MA |
| Q3 | X | X | X | X | X | X | X | X | X | X | 2N6308 | 589698-3 | MA |
| Q4 | X | X | X | X | X | X | X | X | X | X | 2N6308 | 589698-3 | MA |

*P/O PCB Ass'y 165638
**P/O PCB Ass'y 165638-2

Table 6-2
Replaceable Parts List
STM Module VI

| CIRCUIT SYMBOL | STM MODEL 3.5-100 | 5-100 | 9-50 | 12-50 | 15-32 | 18-32 | 24-28 | 28-24 | 36-14 | 48-14 | DESCRIPTION | SORENSEN PART NUMBER | MANUFACTURER, TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Capacitors (uF unless noted). | | |
| C1 | X | X | X | X | X | X | X | X | X | X | 0.22, 250V | 587626-67 | SE, 105 |
| C2 | X | X | X | X | X | X | X | X | X | X | 1800, 200V | 587192-1 | CD, FAH |
| C3 | X | X | X | X | X | X | X | X | X | X | 1800, 200V | 587192-1 | CD, FAH |
| C4 | X | X | X | X | X | X | X | X | X | X | 1800, 200V | 587192-1 | CD, FAH |
| C5 | X | X | X | X | X | X | X | X | X | X | 0.02, 1KV | 24-2029 | SP, C023 |
| C6 | X | X | X | X | X | X | X | X | X | X | 0.02, 1KV | 24-2029 | SP, C023 |
| *C7 | X | X | X | X | X | X | X | X | X | X | 0.22, 250V | 24-2015-17 | SE, MMK |
| *C8 | X | X | X | X | X | X | X | X | X | X | 560pF, 300V | 235-7053P317 | EMC, DM15 |
| *C9 | X | X | X | X | X | X | X | X | X | X | 560pF, 300V | 235-7053P317 | EMC, DM15 |
| *C10 | X | X | X | X | X | X | X | X | X | X | 560pF, 300V | 235-7053P317 | EMC, DM15 |
| *C11 | X | X | X | X | X | X | X | X | X | X | 560pF, 300V | 235-7053P317 | EMC, DM15 |
| *C12 | X | X | | | | | | | | | 220, 10V | 586057-10 | UC, MIL-C-39003 |
| | | | X | X | | | | | | | 100, 20V | 586385-10 | UC, T110 |
| | | | | | X | X | X | | | | 47, 35V | 586058-27 | UC, MIL-C-39003 |
| | | | | | | | | X | | | 18, 50V | 585071-44 | UC, MIL-C-39003 |
| | | | | | | | | | X | X | 10, 75V | 586386-8 | UC, MIL-C-39003 |
| C13 | X | X | | | | | | | | | 0.0033, 200V | 24-2409-4 | AX, V146XR |
| | | | X | X | | | | | | | 0.001, 200V | 24-2409-1 | AX, V146XR |
| | | | | | X | X | | | | | 560pF, 300V | 235-7053P317 | EMC, DM15 |
| | | | | | | | X | | | | 330pF, 300V | 235-7053P140 | EMC, DM15 |
| | | | | | | | | X | | | 270pF, 300V | 235-7053P132 | EMC, DM15 |
| | | | | | | | | | X | X | Not Used | | |
| C14 | X | X | | | | | | | | | 0.0033, 200V | 24-2409-4 | AX, V146XR |
| | | | X | X | | | | | | | 0.001, 200V | 24-2409-1 | AX, V146XR |
| | | | | | X | X | X | X | X | X | Not Used | | |
| C15A | | | X | X | X | X | | | | | 9000, 25V | 587193-1 | SAN, 100 |
| | | | | | | | X | X | | | 5200, 40V | 587193-2 | SAN, 100 |
| | | | | | | | | | X | X | 3300, 75V | 24-2593-2 | SAN, 500 |
| | X | X | | | | | | | | | 47K, 7.5V | 587194-1 | SP, 32D |
| C15B | X | X | | | | | | | | | Not Used | | |
| | | | X | X | X | X | | | | | 9000, 25V | 587193-1 | SAN, 100 |
| | | | | | | | X | X | | | 5200, 40V | 587193-2 | SAN, 100 |
| | | | | | | | | | X | X | 3300, 75V | 24-2593-2 | SAN, 500 |
| C15C | X | X | | | X | X | X | X | | | Not Used | | |
| | | | X | X | | | | | | | 9000, 25V | 587193-1 | SAN, 100 |
| | | | | | | | | | X | X | 3300, 75V | 24-2593-2 | SAN, 500 |
| C16 | X | X | X | X | X | X | X | X | X | X | 0.022, 200V | 24-2409-9 | AX, V146XR |
| C17 | X | X | X | X | X | X | X | X | X | X | 0.22, 250V | 587626-99 | SE, 105 |
| C18 | X | X | | | | | | | | | 220, 10V | 586057-10 | UC, MIL-C-39003 |
| | | | X | X | | | | | | | 100, 20V | 586385-10 | UC, T110 |
| | | | | | X | X | X | | | | 47, 35V | 586058-27 | UC, MIL-C-39003 |
| | | | | | | | | X | | | 18, 50V | 585071-44 | UC, MIL-C-39003 |
| | | | | | | | | | X | X | 10, 75V | 586386-8 | UC, MIL-C-39003 |
| C19 | X | X | X | X | X | X | X | X | X | X | 0.33, 250V | 587626-68 | SE, 105 |
| C20 | X | X | X | X | X | X | X | X | X | X | 0.068, 250V | 587626-63 | SE, 105 |
| C21 | X | X | X | X | X | X | X | X | X | X | 0.068, 250V | 587626-63 | SE, 105 |
| C22 | X | X | X | X | X | X | X | X | X | X | 0.47, 250V | 587626-69 | SE, 105 |
| C23 | X | X | X | X | X | X | X | X | X | X | 270pF, 500V | 235-7053P297 | EMC, DM15 |
| C24 | X | X | X | X | X | X | X | X | X | X | 270pF, 500V | 235-7053P297 | EMC, DM15 |
| C25 | X | X | X | X | X | X | X | X | X | X | 0.001, 1.5KV | 235-7355P316 | EMC, DM20 |
| C26 | X | X | X | X | X | X | X | X | X | X | 0.001, 1.5KV | 235-7355P316 | EMC, DM20 |
| C27 | X | X | X | X | X | X | X | X | X | X | 0.001, 1.5KV | 235-7355P316 | EMC, DM20 |
| C28 | X | X | X | X | X | X | X | X | X | X | 0.001, 1.5KV | 235-7355P316 | EMC, DM20 |

*P/O PCB Ass'y 165638

Table 6-2
Replaceable Parts List
STM Module VI
(cont'd)

| CIRCUIT SYMBOL | STM MODEL 3.5-100 | 5-100 | 9-50 | 12-50 | 15-32 | 18-32 | 24-28 | 28-24 | 36-14 | 48-14 | DESCRIPTION | SORENSEN PART NUMBER | MANUFACTURER, TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Diodes | | |
| CR1 | X | X | X | X | X | X | X | X | X | X | Bridge, 25A, 400V | 980893-3 | VARO, K013 |
| *CR2 | X | X | X | X | X | X | X | X | X | X | A114D | 586379-6 | GE |
| *CR3 | X | X | X | X | X | X | X | X | X | X | A114D | 586379-6 | GE |
| *CR4 | X | X | X | X | X | X | X | X | X | X | A114D | 586379-6 | GE |
| *CR5 | X | X | X | X | X | X | X | X | X | X | A114D | 586379-6 | GE |
| CR6A | X | X | | | | | | | | | Schottky, SD5178 | 165196-2 | TRW |
| | | | X | X | | | | | | | IN3900 | 588097-2 | WH |
| | | | | | X | X | X | X | | | IN3901 | 588097-3 | WH |
| | | | | | | | | | X | X | SCPA3F | 586462-4 | SEM |
| CR6B | X | X | | | | | | | | | Schottky, SD5178 | 165196-2 | TRW |
| | | | X | X | | | | | | | IN3900 | 588097-2 | WH |
| | | | | | X | X | X | X | | | IN3901 | 588097-3 | WH |
| | | | | | | | | | X | X | Not Used | | |
| CR7A | X | X | | | | | | | | | Schottky, SD5178 | 165196-2 | TRW |
| | | | X | X | | | | | | | IN3900 | 588097-2 | WH |
| | | | | | X | X | X | X | | | Not Used | | |
| | | | | | | | | | X | X | SCPA3F | 586462-4 | SEM |
| CR7B | X | X | | | | | | | | | Schottky, SD5178 | 165196-2 | TRW |
| | | | X | X | | | | | | | IN3900 | 588097-2 | WH |
| | | | | | X | X | X | X | X | X | Not Used | | |
| F1 | X | X | X | X | X | X | X | X | X | X | Fuse, 15A, 32V | 226-7176P50 | LF, AGC |
| F2 | X | X | X | X | X | X | X | X | X | X | Fuse, 8A, 125V | 226-7176P54 | LF, AGC |
| | | | | | | | | | | | Inductors (uF unless noted) | | |
| L1A | X | X | X | X | X | X | X | X | X | X | 200 | 587181-1 | SR |
| L1B | X | X | X | X | X | X | X | X | X | X | 200 | 587181-1 | SR |
| **L1-2A | X | X | | | | | | | | | Not Used | | |
| | | | X | X | X | X | X | X | X | X | Ass'y | 165637-1 | SR |
| **L1-2B | X | X | | | | | | | | | Not Used | | |
| | | | X | X | X | X | X | X | X | X | Ass'y | 165637-1 | SR |
| L2A | X | X | X | X | X | X | X | X | X | X | 200 | 587181-2 | SR |
| L2B | X | X | X | X | X | X | X | X | X | X | 200 | 587181-2 | SR |
| L3 | X | X | X | X | X | X | X | X | X | X | 20 | 587156-1 | SR |
| L4 | X | X | X | X | X | X | X | X | X | X | 20 | 587156-1 | SR |
| L5 | X | X | | | | | | | | | 21.1 | 587136-1 | SR |
| | | | X | X | | | | | | | 84.5 | 587136-2 | SR |
| | | | | | X | X | | | | | 190 | 587136-3 | SR |
| | | | | | | | X | X | | | 322 | 587136-4 | SR |
| | | | | | | | | | X | X | 1170 | 587136-5 | SR |
| L6 | X | X | | | | | | | | | 3.5 | 587163-1 | SR |
| | | | X | X | | | | | | | 7.05 | 587163-2 | SR |
| | | | | | X | X | X | | | | 15 | 587163-3 | SR |
| | | | | | | | | X | | | 39.2 | 587163-4 | SR |
| | | | | | | | | | X | X | 70.5 | 587163-5 | SR |
| L7 | X | X | | | | | | | | | 14.5 | 166171-1 | SR |
| | | | X | X | | | | | | | 33 | 166172-1 | SR |
| | | | | | X | X | X | X | | | 90 | 166173-1 | SR |
| | | | | | | | | | X | X | 230 | 166174-1 | SR |

*P/O PCB Ass'y 165638
**P/O PCB Ass'y 165638-2

Table 6-2
Replaceable Parts List
STM Module VI
(cont'd)

| CIRCUIT SYMBOL | STM MODEL 3.5-100 | 5-100 | 9-50 | 12-50 | 15-32 | 18-32 | 24-28 | 28-24 | 36-14 | 48-14 | DESCRIPTION | SORENSEN PART NUMBER | MANUFACTURER, TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Transistors | | |
| Q1 | X | X | X | X | X | X | X | X | X | X | 64135 | 588150-1 | RCA, 65115 |
| Q2 | X | X | X | X | X | X | X | X | X | X | 64135 | 588150-1 | RCA, 65115 |
| Q3 | X | X | X | X | X | X | X | X | X | X | 64135 | 588150-1 | RCA, 65115 |
| Q4 | X | X | X | X | X | X | X | X | X | X | 64135 | 588150-1 | RCA, 65115 |
| | | | | | | | | | | | Resistors (ohms, 1/2W, 10% unless noted) | | |
| R1 | X | X | X | X | X | X | X | X | X | X | 2.5K, 10W, 5% | 27-524 | WL, 10F2500 |
| R2A | X | X | | | | | | | | | 0.33, 6.5W, 6% | 586054-7 | RCL, T5 |
| | | | X | X | X | X | | | | | 0.27, 6.5W, 5% | 586054-6 | RCL, T5 |
| | | | | | | | X | X | X | X | 0.22, 6.5W, 5% | 586054-5 | RCL, T5 |
| R2B | X | X | | | | | | | | | 0.33, 6.5W, 5% | 586054-7 | RCL, T5 |
| | | | X | X | X | X | | | | | 0.27, 6.5W, 5% | 586054-6 | RCL, T5 |
| | | | | | | | X | X | X | X | 0.22, 6.5W, 5% | 586054-5 | RCL, T5 |
| *R4 | X | X | X | X | X | X | X | X | X | X | 20K, 6W, 5% | 167397-1 | Sage, 1550S |
| *R5 | X | X | X | X | X | X | X | X | X | X | 220, 6.5W, 5% | 586054-41 | RCL, T5 |
| *R6 | X | X | X | X | X | X | X | X | X | X | 220, 6.5W, 5% | 586054-41 | RCL, T5 |
| *R7 | X | X | X | X | X | X | X | X | X | X | 220, 6.5W, 5% | 586054-41 | RCL, T5 |
| *R8 | X | X | X | X | X | X | X | X | X | X | 220, 6.5W, 5% | 586054-41 | RCL, T5 |
| R9 | X | X | | | | | | | | | 0.1, 3W | 27-397-1 | WL, 3X |
| | | | X | X | | | | | | | 0.22, 3W | 27-397-9 | WL, 3X |
| | | | | | X | X | X | X | | | 0.56, 3W | 27-397-19 | WL, 3X |
| | | | | | | | | | X | X | 3.3, 3W | 27-397-37 | WL, 3X |
| R10 | X | X | | | | | | | | | 1.25 milliohms | 588004-1 | SR |
| | | | X | X | | | | | | | 6 milliohms | 588004-2 | SR |
| | | | | | X | X | | | | | 8.5 milliohms | 588004-3 | SR |
| | | | | | | | X | X | | | 12.5 milliohms | 588004-4 | SR |
| | | | | | | | | | X | X | 35 milliohms | 587961-1 | SR |
| R11 | X | | | | | | | | | | 0.887, 50W 1% | 586677-92 | RCL, AL-50 |
| | | X | | | | | | | | | 1.21, 50W, 3% | 586677-500 | RCL, AL-50 |
| | | | X | | | | | | | | 4.02, 50W, 3% | 586677-511 | RCL, AL-50 |
| | | | | X | | | | | | | 5.36, 50W, 1% | 586677-167 | RCL, AL-50 |
| | | | | | X | | | | | | 12.1, 50W, 3% | 586677-517 | RCL, AL-50 |
| | | | | | | X | | | | | 14.3, 50W, 1% | 586677-208 | RCL, AL-50 |
| | | | | | | | X | | | | 19.6, 50W, 1% | 586677-221 | RCL, AL-50 |
| | | | | | | | | X | | | 24.9, 50W, 1% | 586677-522 | RCL, AL-50 |
| | | | | | | | | | X | | 71.5, 50W, 1% | 586677-275 | RCL, AL-50 |
| | | | | | | | | | | X | 93.1, 50W, 1% | 586677-286 | RCL, AL-50 |
| R12 | X | X | X | X | X | X | X | X | X | X | 0.22, 12.5W | 27-590-9 | WL, 12.5X |
| R13 | X | X | X | X | X | X | X | X | X | X | 0.22, 12.5W | 27-590-9 | WL, 12.5X |
| R14 | X | X | X | X | X | X | X | X | X | X | 10 | 280-1145P2 | AB, EB |
| R15 | X | X | X | X | X | X | X | X | X | X | 10 | 280-1145P2 | AB, EB |
| R16 | X | X | X | X | X | X | X | X | X | X | 1K, 2W | 280-1147P74 | AB, HB |
| R17 | X | X | X | X | X | X | X | X | X | X | 1K, 2W | 280-1147P74 | AB, HB |
| R18 | X | X | X | X | X | X | X | X | X | X | 47K, 2W | 280-1147P134 | AB, HB |
| R19 | X | X | X | X | X | X | X | X | X | X | 47K, 2W | 280-1147P134 | AB, HB |
| R20 | X | X | X | X | X | X | X | X | X | X | 330, 3W, 5% | 167401-101 | Tel-Labs EL-21 |
| R21 | X | X | X | X | X | X | X | X | X | X | 330, 3W, 5% | 167401-101 | |
| R22 | X | X | X | X | X | X | X | X | X | X | 330, 3W, 5% | 167401-101 | |
| R23 | X | X | X | X | X | X | X | X | X | X | 330, 3W, 5% | 167401-101 | |
| RT1 | X | X | X | X | X | X | X | X | X | X | Thermistor | 165541-1 | KC, RL10007 |
| RT2 | X | X | X | X | X | X | X | X | X | X | Thermistor | 165541-1 | KC, RL10007 |

*P/O PCB Ass'y 165638

Table 6-2
Replaceable Parts List
STM Module VI
(cont'd)

| CIRCUIT SYMBOL | STM MODEL 3.5-100 | 5-100 | 9-50 | 12-50 | 15-32 | 18-32 | 24-28 | 28-24 | 36-14 | 48-14 | DESCRIPTION | SORENSEN PART NUMBER | MANUFACTURER, TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Transformers | | |
| T1 | X | X | | | | | | | | | Ass'y | 587143-1 | SR |
| | | | X | X | | | | | | | Ass'y | 587143-2 | SR |
| | | | | | X | X | | | | | Ass'y | 587143-3 | SR |
| | | | | | | | X | | | | Ass'y | 587143-4 | SR |
| | | | | | | | | X | | | Ass'y | 587143-5 | SR |
| | | | | | | | | | X | X | Ass'y | 587143-6 | SR |

Table 6-3
Replaceable Parts
Output PCB Assy A200
587155 (Module/VA)

| CIRCUIT SYMBOL | STM MODEL 3.5-60 | 5-60 | 9-30 | 12-30 | 15-24 | 18-24 | 24-21 | 28-18 | 36-10 | 48-10 | DESCRIPTION | SORENSEN PART NUMBER | MANUFACTURER, TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Capacitors (uF unless noted) | | |
| C1 | X | X | X | X | X | X | X | X | X | X | 1, 100V | 24-2037-19 | SE, MMK |
| C3 | X | X | X | X | X | X | X | X | X | X | 0.01, 250V | 24-2015-1 | SE, MMK |
| C4 | X | X | X | X | X | X | X | X | X | X | 0.01, 250V | 24-2015-1 | SE, MMK |
| C5 | X | X | X | X | | | | | | | 15, 20V | 586385-8 | UC, T110 |
| | | | | | X | X | X | X | X | X | Not Used | | |
| C6 | X | X | X | X | | | | | | | 0.1, 250V | 24-2015-13 | SE, MMK |
| | | | | | X | X | X | X | X | X | Not Used | | |
| C7 | X | X | X | X | | | | | | | 0.1, 250V | 24-2015-13 | SE, MMK |
| | | | | | X | X | X | X | X | X | Not Used | | |
| C8 | X | X | X | X | X | X | X | X | X | X | 4.7, 10V | 586057-2 | UC, MIL-C-39003 |
| C10 | X | X | X | X | X | X | X | X | X | X | 0.01, 250V | 24-2015-1 | SE, MMK |
| | | | | | | | | | | | Diodes | | |
| CR1 | X | X | X | X | | | | | | | S12 | 587565-2 | SEM |
| | | | | | X | X | X | X | X | X | Not Used | | |
| CR2 | X | X | X | X | | | | | | | S12 | 587565-2 | SEM |
| | | | | | X | X | X | X | X | X | Not Used | | |
| CR3 | X | X | X | X | | | | | | | S12 | 587565-2 | SEM |
| | | | | | X | X | X | X | X | X | Not Used | | |
| CR4 | X | X | X | X | | | | | | | S12 | 587565-2 | SEM |
| | | | | | X | X | X | X | X | X | Not Used | | |
| CR5 | X | X | X | X | | | | | | | S12 | 587565-2 | SEM |
| | | | | | X | X | X | X | X | X | Not Used | | |
| CR6 | X | X | X | X | X | X | X | X | X | X | S12 | 587565-2 | SEM |
| CR7 | | | X | X | | | | | | | S12 | 587565-2 | SEM |
| | X | X | | | X | X | X | X | X | X | Not Used | | |
| | | | | | | | | | | | Inductors | | |
| L1 | X | X | X | X | X | X | X | X | X | X | Toroid Coil | 586471-1 | SR |
| L2 | X | X | X | X | | | | | | | Toroid Coil | 586471-1 | SR |
| | | | | | X | X | X | X | X | X | Not Used | | |
| | | | | | | | | | | | Transistors | | |
| Q1 | X | X | X | X | | | | | | | 2N2907 | 386-7249P58 | GE |
| | | | | | X | X | X | X | X | X | Not Used | | |
| Q2 | X | X | X | X | | | | | | | 2N6027 | 386-7304P1 | GE |
| | | | | | X | X | X | X | X | X | 2N4990 | 586063-2 | GE |
| | | | | | | | | | | | Resistors (ohms, 1/2W, 10% unless noted) | | |
| R1 | | | | | | | | | | | Not Used | | |
| R2 | X | | X | | X | | X | | X | | Not Used | | |
| | | X | | | | | | | | | 1.5K, 1/8W, 1% | 586055-185 | ELA, MF4 |
| | | | | X | | X | | | | | 2.94K, 1/8 W, 1% | 586055-186 | ELA, MF4 |
| | | | | | | | X | | | | 4.99K, 1/8W, 1% | 586055-187 | ELA, MF4 |
| | | | | | | | | | X | | 13K, 1/8W, 1% | 586055-189 | ELA, MF4 |
| R3 | X | X | | | | | | | | | 2.94K, 1/8W, 1% | 586055-186 | ELA, MF4 |
| | | | X | X | | | | | | | 5.9K, 1/8W, 1% | 586055-111 | ELA, MF4 |
| | | | | | X | X | | | | | 12.7K, 1/8W, 1% | 586055-127 | ELA, MF4 |
| | | | | | | | X | X | | | 18.7K, 1/8W, 1% | 586055-135 | ELA, MF4 |
| | | | | | | | | | X | X | 28.7K, 1/8W, 1% | 586055-144 | ELA, MF4 |

Table 6-3
Replaceable Parts
Output PCB Assy A200
587155 (Module/VA)
(cont'd)

| CIRCUIT SYMBOL | STM MODEL 3.5-60 | 5-60 | 9-30 | 12-30 | 15-24 | 18-24 | 24-21 | 28-18 | 36-10 | 48-10 | DESCRIPTION | SORENSEN PART NUMBER | MANUFACTURER, TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R4 | X | X | | | | | | | | | 2K, Variable | 586371-5 | BNS, 3006P |
| | | | X | X | X | X | | | | | 5K, Variable | 586371-6 | BNS, 3006P |
| | | | | | | X | X | | | | 10K, Variable | 586371-7 | BNS, 3006P |
| | | | | | | | | X | X | | 20K, Variable | 586371-8 | BNS, 3006P |
| R5 | X | X | X | X | X | X | X | X | X | | 1K | 280-1145P74 | AB, EB |
| R6 | X | X | X | X | | | | | | | 10 | 280-1145P2 | AB, EB |
| | | | | | X | X | X | X | X | X | Not Used | | |
| R7 | X | X | X | X | | | | | | | 82, 5% | 28-2000 | AB, EB |
| | | | | | X | X | X | X | X | X | Not Used | | |
| R8 | X | X | X | X | | | | | | | 4.7K | 280-1145P98 | AB, EB |
| | | | | | X | X | X | X | X | X | Not Used | | |
| R9 | X | X | X | X | X | X | X | X | | | 2K, Variable | 586371-5 | BNS, 3006P |
| | | | | | | | | X | X | | 5K, Variable | 586371-6 | BNS, 3006P |
| R10 | X | X | X | X | | | | | | | 1.3K, 1/4W, 1% | 28-1333 | IRC, CEA-TO |
| | | | | | X | X | | | X | X | 680, 1/8W, 1% | 586250-66 | ELA, MF4 |
| | | | | | | | X | X | | | 422, 1/8W, 1% | 586250-56 | ELA, MF4 |
| R11 | X | X | X | X | | | | | | | 3.3K | 280-1145P91 | AB, EB |
| | | | | | X | X | X | X | X | X | Not Used | | |
| R12 | X | X | | | | | | | X | X | 1.3K, 1/4W, 1% | 28-1333 | IRC, CEA-TO |
| | | | X | X | | | | | | | 7.15K, 1/8W, 1% | 586250-115 | ELA, MF4 |
| | | | | | X | X | | | | | 280, 1/4W, 1% | 28-1284 | IRC, CEA-TO |
| | | | | | | | X | X | | | 422, 1/8W, 1% | 586250-56 | ELA, MF4 |
| R13 | X | X | X | X | | | | | | | 3.32K, 1/8W, 1% | 586250-99 | ELA, MF4 |
| | | | | | X | X | X | X | X | X | Not Used | | |
| R14 | X | X | X | X | X | X | X | X | X | X | 33 | 280-1145P20 | AB, EB |
| R16 | X | X | X | X | X | X | X | X | X | X | 100 | 280-1145P38 | AB, EB |
| R17 | X | X | | | X | X | X | X | X | X | Not Used | | |
| | | | X | X | | | | | | | 390 | 280-1145P59 | AB, EB |
| VR1 | X | X | X | X | | | | | | | Zener 1N825 | 588105-3 | MA |
| | | | | | X | X | X | X | X | X | Not Used | | |
| | | | | | | | | | | | Output PC8 Ass'y | | |
| | X | | | | | | | | | | | 587155-1 | SR |
| | | X | | | | | | | | | | 587155-2 | SR |
| | | | X | | | | | | | | | 587155-3 | SR |
| | | | | X | | | | | | | | 587155-4 | SR |
| | | | | | X | | | | | | | 587155-5 | SR |
| | | | | | | X | | | | | | 587155-6 | SR |
| | | | | | | | X | | | | | 587155-7 | SR |
| | | | | | | | | X | | | | 587155-8 | SR |
| | | | | | | | | | X | | | 587155-9 | SR |
| | | | | | | | | | | X | | 587155-10 | SR |

Table 6-4
Replaceable Parts
Output PCB Ass'y A200
587155 (Module VI)

| CIRCUIT SYMBOL | STM MODEL 3.5-100 | 5-100 | 9-50 | 12-50 | 15-32 | 18-32 | 24-28 | 28-24 | 36-14 | 48-14 | DESCRIPTION | SORENSEN PART NUMBER | MANUFACTURER, TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Capacitors (uF unless noted) | | |
| C1 | X | X | X | X | X | X | X | X | X | X | 1, 100V | 24-2037-19 | SE, MMK |
| C3 | X | X | X | X | X | X | X | X | X | X | 0.01, 250V | 24-2015-1 | SE, MMK |
| C4 | X | X | X | X | X | X | X | X | X | X | 0.01, 250V | 24-2015-1 | SE, MMK |
| C5 | X | X | X | X | | | | | | | 15, 20V | 586385-8 | UC, T110 |
| | | | | | X | X | X | X | X | X | Not Used | | |
| C6 | X | X | X | X | | | | | | | 0.1, 250V | 24-2015-13 | SE, MMK |
| | | | | | X | X | X | X | X | X | Not Used | | |
| C7 | X | X | X | X | | | | | | | 0.1, 250V | 24-2015-13 | SE, MMK |
| | | | | | X | X | X | X | X | X | Not Used | | |
| C8 | X | X | X | X | X | X | X | X | X | X | 4.7, 10V | 586057-2 | UC, MIL-C-39003 |
| C10 | X | X | X | X | X | X | X | X | X | X | 0.01, 250V | 24-2015-1 | SE, MMK |
| | | | | | | | | | | | Diodes | | |
| CR1 | X | X | X | X | | | | | | | S12 | 587565-2 | SEM |
| | | | | | X | X | X | X | X | X | Not Used | | |
| CR2 | X | X | X | X | | | | | | | S12 | 587565-2 | SEM |
| | | | | | X | X | X | X | X | X | Not Used | | |
| CR3 | X | X | X | X | | | | | | | S12 | 587562-2 | SEM |
| | | | | | X | X | X | X | X | X | Not Used | | |
| CR4 | X | X | X | X | | | | | | | S12 | 587565-2 | SEM |
| | | | | | X | X | X | X | X | X | Not Used | | |
| CR5 | X | X | X | X | | | | | | | S12 | 587565-2 | SEM |
| | | | | | X | X | X | X | X | X | Not Used | | |
| CR6 | X | X | X | X | X | X | X | X | X | X | S12 | 587565-2 | SEM |
| CR7 | | | X | X | | | | | | | S12 | 587565-2 | SEM |
| | X | X | | | X | X | X | X | X | X | Not Used | | |
| | | | | | | | | | | | Inductors | | |
| L1 | X | X | X | X | X | X | X | X | X | X | Toroid Coil | 586471-1 | SR |
| L2 | X | X | X | X | | | | | | | Toroid Coil | 586471-1 | SR |
| | | | | | X | X | X | X | X | X | Not Used | | |
| | | | | | | | | | | | Transistors | | |
| Q1 | X | X | X | X | | | | | | | 2N2907A | 386-7249P58 | GE |
| | | | | | X | X | X | X | X | X | Not Used | | |
| Q2 | X | X | X | X | | | | | | | 2N6027 | 386-7304P1 | GE |
| | | | | | X | X | X | X | X | X | 2N4990 | 586063-2 | GE |
| | | | | | | | | | | | Resistors (ohm, 1/2W, 10% unless noted) | | |
| R1 | | | | | | | | | | | Not Used | | |
| R2 | | X | | | | | | | | | 1.5K, 1/8W, 1% | 586055-185 | ELA, MF4 |
| | X | | | X | | X | | | | | 2.94K, 1/8W, 1% | 586055-186 | ELA, MF4 |
| | | | | | | | X | | | | 4.99K, 1/8W, 1% | 586055-187 | ELA, MF4 |
| | | | | | | | | | X | | 13K, 1/8W, 1% | 586055-189 | ELA, MF4 |
| | | X | | X | | X | | X | | | Not Used | | |
| R3 | X | X | | | | | | | | | 2.94K, 1/8W, 1% | 586055-186 | ELA, MF4 |
| | | | X | X | | | | | | | 5.9K, 1/8W, 1% | 586055-111 | ELA, MF4 |
| | | | | | X | X | | | | | 12.7K, 1/8W, 1% | 586055-127 | ELA, MF4 |
| | | | | | | | X | X | | | 18.7K, 1/8W, 1% | 586055-135 | ELA, MF4 |
| | | | | | | | | | X | X | 28.7K, 1/8W, 1% | 586055-144 | ELA, MF4 |

Table 6-4
Replaceable P rts
Output PCB Ass'y A200
587155 (Module VI)
(cont'd)

| CIRCUIT SYMBOL | STM MODEL 3.5-100 | 5-100 | 9-50 | 12-50 | 15-32 | 18-32 | 24-28 | 28-24 | 36-14 | 48-14 | DESCRIPTION | SORENSEN PART NUMBER | MANUFACTURER, TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R4 | X | X | | | | | | | | | 2K Variable | 586371-5 | BNX, 3006P |
| | | | X | X | X | X | | | | | 5K Variable | 586371-6 | BNS, 3006P |
| | | | | | | X | X | | | | 10K Variable | 586371-7 | BNS, 3006P |
| | | | | | | | | X | X | | 20K Variable | 586371-8 | BNS, 3006P |
| R5 | X | X | X | X | X | X | X | X | X | | 1K | 280-1145P74 | AB, EB |
| R6 | X | X | X | X | | | | | | | 10 | 280-1145P2 | AB, EB |
| | | | | | X | X | X | X | X | X | Not Used | | |
| R7 | X | X | X | X | | | | | | | 82.5% | 28-2000 | AB, EB |
| | | | | | X | X | X | X | X | X | Not Used | | |
| R8 | X | X | X | X | | | | | | | 4.7K | 280-1145P98 | AB, EB |
| | | | | | X | X | X | X | X | X | Not Used | | |
| R9 | X | X | X | X | X | X | X | X | | | 2K Variable | 586371-5 | BNS, 3006P |
| | | | | | | | | | X | X | 5K Variable | 586371-6 | BNS, 3006P |
| R10 | X | X | X | X | | | | | | | 1.3K, 1/4W, 1% | 28-1333 | IRC, CEA-TO |
| | | | | | X | X | | | X | X | 680, 1/8W, 1% | 586250-66 | ELA, MF4 |
| | | | | | | | X | X | | | 422, 1/8W, 1% | 586250-56 | ELA, MF4 |
| R11 | X | X | X | X | | | | | | | 3.3K | 280-1145P91 | AB, EB |
| | | | | | X | X | X | X | X | X | Not Used | | |
| R12 | X | X | | | | | | | X | X | 1.3K, 1/4W, 1% | 28-1333 | IRC; CEA-TO |
| | | | X | X | | | | | | | 7.15K, 1/8W, 1% | 586250-115 | ELA, MF4 |
| | | | | | X | X | | | | | 280, 1/4W, 1% | 28-1284 | IRC, CEA-TO |
| | | | | | | | X | X | | | 422, 1/8W, 1% | 586250-56 | ELA, MF4 |
| R13 | X | X | X | X | | | | | | | 3.32K, 1/8W, 1% | 586250-99 | ELA, MF4 |
| | | | | | X | X | X | X | X | X | Not Used | | |
| R14 | X | X | X | X | X | X | X | X | X | X | 33 | 280-1145P20 | AB, EB |
| R16 | X | X | X | X | X | X | X | X | X | X | 100 | 280-1145P38 | AB, EB |
| R17 | | | X | X | | | | | | | 390 | 280-1145P59 | AB, EB |
| | X | X | | | X | X | X | X | X | X | Not Used | | |
| VR1 | X | X | X | X | | | | | | | Zener 1N825 | 588105-3 | MA |
| | | | | | X | X | X | X | X | X | Not Used | | |
| | | | | | | | | | | | Output PCB Ass'y | | |
| | X | | | | | | | | | | | 587155-1 | SR |
| | | X | | | | | | | | | | 587155-2 | SR |
| | | | X | | | | | | | | | 587155-3 | SR |
| | | | | X | | | | | | | | 587155-4 | SR |
| | | | | | X | | | | | | | 587155-5 | SR |
| | | | | | | X | | | | | | 587155-6 | SR |
| | | | | | | | X | | | | | 587155-7 | SR |
| | | | | | | | | X | | | | 587155-8 | SR |
| | | | | | | | | | X | | | 587155-9 | SR |
| | | | | | | | | | | X | | 587155-10 | SR |

Table 6-5
Replaceable Parts
Control PCB Ass'y A100
587121-1

| CIRCUIT SYMBOL | DESCRIPTION | SORENSEN PART NUMBER | MANUFACTURER, TYPE |
|---|---|---|---|
| Capacitors | (uF unless noted) | | |
| C1 | .01, 25V | 235-7426P1 | RDM, M-25 |
| C2 | 39, 10V | 586057-5 | UC, MIL-C-39003 |
| C3 | .0033 | 24-2409-4 | AX, V146XR |
| C4 | 100pF, 500V | 235-7053P254 | EMC, DM15 |
| C5 | 15, 20V | 586385-5 | UC, T110 |
| C6 | 15, 20V | 586385-5 | UC, T110 |
| C7 | .001, 1KV | 235-7421P14 | RDM, JF |
| C8 | 4.7, 10V | 586057-2 | UC, MIL-C-39003 |
| C9 | 15, 20V | 586385-5 | UC, T110 |
| C10 | 6.8, 35V | 586058-17 | UC, MIL-C-39003 |
| C11 | .068, 250V | 24-2015-11 | SE, MMK |
| C12 | .22, 100V | 24-2037-11 | SE, MMK |
| C13 | .22, 100V | 24-2037-11 | SE, MMK |
| C14 | .22, 100V | 24-2037-11 | SE, MMK |
| C15 | .22, 100V | 24-2037-11 | SE, MMK |
| C16 | Not Used | | |
| C17 | .0047, 200V | 24-2409-5 | AX, V146XR |
| C18 | .0047, 200V | 24-2409-5 | AX, V146XR |
| C19 | 6.8, 35V | 586058-17 | UC, MIL-C-39003 |
| C20 | 4.7, 10V | 586057-2 | UC, MIL-C-39003 |
| C21 | .01, 200V | 24-2409-7 | AX, V146XR |
| C22 | Not Used | | |
| C23 | 2.2, 20V | 586385-2 | UC, T110 |
| C24 | Not Used | | |
| C25 | .015, 250V | 24-2015-3 | SE, MMK |
| C26 | .0022, 200V | 24-2409-3 | AX, V146XR |
| C27 | .015, 250V | 24-2015-3 | SE, MMK |
| C28 | .0033, 200V | 24-2409-4 | AX, V146XR |
| C29 | .001, 1KV | 235-7421P14 | RDM, JF |
| C30 | 330pF, 300V | 235-7053P141 | EMC, DM15 |
| C31 | Not Used | | |
| C32 | 39, 10V | 586057-5 | UC, MIL-C-39003 |
| C33 | .01, 25V | 235-7426P1 | RDM, M-25 |
| C34 | .01, 25V | 235-7426P1 | RDM, M-25 |
| Diodes | | | |
| CR1 | 1N4003 | 587565-2 | SEM, S12 |
| CR2 | 1N4003 | 587565-2 | SEM, S12 |
| CR3 | 1N4003 | 587565-2 | SEM, S12 |
| CR4 | S1F05 | 586379-1 | SEM, S1F05 |
| CR5 | S1F05 | 586379-1 | SEM, S1F05 |
| CR6 | S1F4 | 586379-6 | SEM, S1F4 |
| CR7 | S1F4 | 586379-6 | SEM, S1F4 |
| CR8 | 1N4003 | 587565-2 | SEM, S12 |
| CR9 | 1N4003 | 587565-2 | SEM, S12 |
| CR10 | 1N4003 | 587565-2 | SEM, S12 |
| CR11 | 1N4003 | 587565-2 | SEM, S12 |
| CR12 | 1N4003 | 587565-2 | SEM, S12 |
| CR13 | 1N4003 | 597565-2 | SEM, S12 |
| CR14 | 1N4003 | 587565-2 | SEM, S12 |
| CR15 | 1N4003 | 587565-2 | SEM, S12 |
| CR16 | 1N4003 | 587565-2 | SEM, S12 |
| CR17 | 1N4003 | 587575-2 | SEM, S12 |
| CR18 | Not Used | | |
| CR19 | S1F05 | 586379-1 | SEM, S1F05 |
| CR20 | S1F05 | 586379-1 | SEM, S1F05 |

Table 6-5
Replaceable Parts
Control PCB Ass'y A100
587121-1 (cont'd)

| CIRCUIT SYMBOL | DESCRIPTION | SORENSEN PART NUMBER | MANUFACTURER, TYPE |
|---|---|---|---|
| Diodes (Cont'd) | | | |
| CR21 | S1F05 | 586379-1 | SEM, S1F05 |
| CR22 | S1F05 | 586379-1 | SEM, S1F05 |
| CR23 | S1F05 | 586379-1 | SEM, S1F05 |
| Cr24 | S1F4 | 586379-6 | SEM, S1F4 |
| CR25 | S1F4 | 586379-6 | SEM, S1F4 |
| Cr26 | S1F4 | 586379-6 | SEM, S1F4 |
| CR27 | S1F4 | 586379-6 | SEM, S1F4 |
| CR28 | 1N4003 | 586565-2 | SEM, S12 |
| CR29 | 1N4003 | 587565-2 | SEM, S12 |
| CR30 | 1N4003 | 387565-2 | SEM, S12 |
| CR31 | 1N4003 | 587565-2 | SEM, S12 |
| CR32 | 1N4003 | 587565-2 | SEM, S12 |
| CR33 | 1N4003 | 587565-2 | SEM, S12 |
| F1 | Fuse, 250mA, 250V | 226-7176P32 | LF, AGC |
| Transistors | | | |
| Q1 | 2N2222A | 386-7249P57 | RCA |
| Q2 | 2N2907A | 386-7249P58 | RCA |
| Q3 | 2N2222A | 386-7249P57 | RCA |
| Q4 | 2N3019 | 386-7316P1 | MA |
| Q5 | 2N6027 | 386-7304P1 | GE |
| Q6 | 2N2222A | 386-7249P57 | RCA |
| Q7 | 2N2907A | 286-7249P58 | RCA |
| Q8 | 2N2907A | 286-7249P58 | RCA |
| Q9 | SJE2300 | 982992-1 | MA |
| Q10 | SJE2300 | 982992-1 | MA |
| Q11 | 2N5062 | 322-7243P3 | MA |
| Q12 | 2N2219A | 386-7249P32 | RCA |
| Q13 | 2N2219A | 386-7249P32 | RCA |
| Q14 | 2N2222A | 386-7249P57 | RCA |
| Q15 | 2N2222A | 386-7249P57 | RCA |
| Q16 | 2N2222A | 386-7249P57 | RCA |
| Q17 | 2N2222A | 386-7249P57 | RCA |
| Q18 | 2N2219A | 386-7249P32 | RCA |
| Q19 | 2N2219A | 386-7249P32 | RCA |
| Q20 | 2N2219A | 386-7249P32 | RCA |
| Q21 | 2N2219A | 386-7249P32 | RCA |
| Q22 | 2N2907A | 386-7249P58 | RCA |
| Q23 | 2N2907A | 386-7249P58 | RCA |
| Q24 | 2N2907A | 386-7249P58 | RCA |
| Q25 | 2N2907A | 386-7249P58 | RCA |
| Q26 | 2N3638 | 18-143 | Fairchild |
| Q27 | 2N2907A | 386-7249P58 | RCA |
| Resistors (ohms, 1/2W, 10% unless noted) | | | |
| R1 | 175K, 1% | 28-1123 | IRC, CEA-TO |
| R2 | 7.5K, 1/8W, 1% | 586250-116 | ELA, MF4 |
| R3 | 12K | 280-1145P113 | AB, EB |
| R4 | 47K | 280-1145P134 | AB, EB |
| R5 | 22K | 280-1145P122 | AB, EB |
| R6 | 4.7K | 280-1145P98 | AB, EB |
| R7 | 1K | 280-1145P74 | AB, EB |

Table 6-5
Replaceable Parts
Control PCB Ass'y A100
587121-1 (cont'd)

| CIRCUIT SYMBOL | DESCRIPTION | SORENSEN PART NUMBER | MANUFACTURER, TYPE |
|---|---|---|---|
| Resistors | (ohms,1/2W, 20% unless noted) | | |
| R8 | 12K | 280-1145P113 | AB, EB |
| R9 | 18.7K, 1/8W, 1% | 586250-135 | ELA, MF4 |
| R10 | 82 | 280-1145P35 | AB, EB |
| R11 | 47 | 280-1145P26 | AB, EB |
| R12 | 10K | 280-1145P110 | AB, EB |
| R13 | 6.8K, 5W, 5% | 586054-59 | RCL, T-5 |
| R14 | 4.7K, 3W, 5% | 27-398-14 | WL, 3X |
| R15 | 4.7K, 3W, 5% | 27-398-14 | WL, 3X |
| R16 | 12K, 1W | 280-1146P113 | AB, RC30/32 |
| R17 | 390 | 280-1145P59 | AB, EB |
| R18 | 10K | 280-1145P110 | AB, EB |
| R19 | 2.87K, 1/8W, 1% | 586250-96 | ELA, MF4 |
| R20 | 2.87K, 1/8W, 1% | 586250-96 | ELA, MF4 |
| R21 | 47 | 280-1145P26 | AB, EB |
| R22 | 10K | 280-1145P110 | AB, EB |
| R23 | 12K | 280-1145P113 | AB, EB |
| R24 | 2.2K | 280-1145P86 | AB, EB |
| R25 | 2.2K | 280-1145P86 | AB, EB |
| R26 | 1K | 280-1145P74 | AB, EB |
| R27 | 1K | 280-1145P74 | AB, EB |
| R28 | 10K, Variable | 586370-7 | BNS, 3389H |
| R29 | 2.87K, 1/8W, 1% | 586250-96 | ELA, MF4 |
| R30 | 2.87K, 1/8W, 1% | 586250-96 | ELA, MF4 |
| R31 | 3.65K, 1/8W, 1% | 586250-101 | ELA, MF4 |
| R32 | 270 | 280-1145P53 | AB, EB |
| R33 | 27K | 280-1145P125 | AB, EB |
| R34 | 3.9K | 280-1145P95 | AB, EB |
| R35 | 270 | 280-1145P53 | AB, EB |
| R36 | 5.6, 3W, 5% | 27-397-43 | WL, 2X |
| R37 | 5.6, 3W, 5% | 27-397-43 | WL, 3X |
| R38 | 5.6, 3W, 5% | 27-397-43 | WL, 3X |
| R39 | 5.6, 3W, 5% | 27-397-43 | WL, 3X |
| R40 | 200 | 280-1145P38 | AB, EB |
| R41 | 100 | 280-1145P38 | AB, EB |
| R42 | 100 | 280-1145P38 | AB, EB |
| R43 | 100 | 280-1145P38 | AB, EB |
| R44 | 470 | 280-1145P62 | AB, EB |
| R45 | 470 | 280-1145P62 | AB, EB |
| R46 | 470 | 280-1145P62 | AB, EB |
| R47 | 470 | 280-1145P62 | AB, EB |
| R48 | 180 | 280-1145P47 | AB, EB |
| R49 | 180 | 280-1145P47 | AB, EB |
| R50 | 180 | 280-1145P47 | AB, EB |
| R51 | 180 | 280-1145P47 | AB, EB |
| R52 | 100K | 280-1145P146 | AB, EB |
| R53 | 47K | 280-1145P134 | AB, EB |
| R54 | 270K | 280-1145P161 | AB, EB |
| R55 | 10K | 280-1145P110 | AB, EB |
| R56 | 10 | 280-1145P52 | AB, EB |
| R57 | 1K | 280-1145P74 | AB, EB |
| R58 | 470 | 280-1145P62 | AB, EB |
| R59 | 18K | 280-1145P119 | AB, EB |
| R60 | 2.2K | 280-1145P86 | AB, EB |
| R61 | 10K, 1/8W, 1% | 586250-122 | ELA, MF4 |
| R62 | 15.4K 1/8W, 1% | 586250-131 | ELA, MF4 |
| R63 | 1.3K, 1/8W, 1% | 28-1333 | IRC, CEA-TO |
| R64 | 53.6K, 1/8W, 1% | 586250-157 | ELA, MR4 |
| R65 | 10K, Variable | 586370-7 | BNS, 3389H |

Table 6-5
Replaceable Parts
Control PCB Ass'y A100
587121-1 (cont'd)

| CIRCUIT SYMBOL | DESCRIPTION | SORENSEN PART NUMBER | MANUFACTURER, TYPE |
|---|---|---|---|
| Resistors | (ohms, 1/2W, 10% unless noted) | | |
| R66 | 10K, Variable | 586370-7 | BNS, 3389H |
| R67 | 6.65K, 1/8W, 1% | 586055-188 | ELA, MF4 |
| R68 | Not Used | | |
| R69 | Not Used | | |
| R70 | 1K, 1/4W | 280-1171P74 | AB, CB |
| R71 | 10K, Variable | 586370-7 | BNS, 3389H |
| R72 | 4.7 | 280-7176P2 | AB, EB |
| R73 | 681, 1/8W, .1% | 586250-66 | ELA, MF4 |
| T1 | Bias Transformer | 589960-1 | SR |
| T2 | Pulse Transformer | 586340-1 | SR |
| Integrated Circuits | | | |
| U1 | IC710C | 386-7277P4 | NS |
| U2 | F/F845C | 587843-1 | MA, MCB45P |
| U3 | IC710C | 386-7277P4 | NS |
| U4 | IC741C | 586372-2 | Fairchild |
| U5 | IC741C | 586372-2 | Fairchild |
| U6 | IC741C | 586372-2 | Fairchild |
| U7 | Opto-Isolator | 586463-3 | TI, TIXL III |
| Zener Diodes | | | |
| VR1 | 1N5242B | 588101-15 | MA |
| VR2 | 1N5230B | 588101-6 | MA |
| VR3 | Not Used | | |
| VR4 | 1N5230B | 588101-6 | MA |
| VR5 | 1N825 | 588105-3 | MA |

Table 6-6
Replaceable Parts List
Preregulator PCB Ass'y
982111-1

| CIRCUIT SYMBOL | DESCRIPTION | SORENSEN PART NUMBER | MANUFACTURER, TYPE |
|---|---|---|---|
| C1 | Capacitor, 3.3uF, 200V | 167394-1 | SP, CDE |
| C2 | Capacitor, 0.001uF, 1000V | 235-7421P14 | RMC, JF |
| C3 | Capacitor, 0.01uF, 25V | 235-7426P1 | RDM, M-25 |
| CR1 | Diode, S16 | 587565-4 | SEM |
| CR2 | Diode, S16 | 587565-4 | SEM |
| Q1 | Transistor, 2N6542 | 167372-1 | |
| Q2 | Transistor, 2N3440 | 386-7249P13 | RCA |
| Q3 | Transistor, 2N3440 | 386-7249P13 | RCA |
| Q4 | Transistor, 2N2222A | 386-7249P57 | RCA |
| | Resistors (ohms) | | |
| R1 | 4.7K, 1W, 10% | 280-1180P98 | AB, 032 |
| R2 | 22K, 2W, 10% | 280-1147P122 | AB, HB |
| R3 | 150K, 1/2W, 2% | 585326-219 | CG, C5 |
| R4 | 470, 1/4W, 2% | 585108-87 | CG, C4 |
| R5 | 560, 1/4W, 2% | 585108-91 | CG, C4 |
| R6A | 4.7, 1/2W, 2% | 585326-3 | CG, C5 |
| R6B | 10, 1/4W, 2% | 585108-151 | CG, C4 |
| R7 | 33K, 1/2W, 2% | 585326-188 | CG, C5 |
| R8 | 33K, 1/2W, 2% | 585326-188 | CG, C5 |
| R9 | 1K, 1/2W Variable | 586370-4 | BNS, 3389H |
| R10 | 3.3K, 1/4W, 2% | 585108-35 | CG, C4 |
| VR1 | Diode, Zener, 1N4741A | 588102-8 | MA |

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